NUCLEAR SCIENCE ABSTRACTS

January 15, 1960

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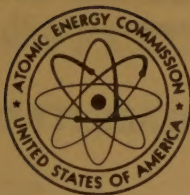**WEST VIRGINIA**
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NUCLEAR SCIENCE ABSTRACTS

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CONTENTS

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Legal Notice

NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

1   HW-58220
General Electric Co. Hanford Atomic Products Opera-
tion, Richland, Wash.
OPERATING MANUAL FOR 105-C METAL EXAMINA-
TION FACILITY. J. M. Fouts. Oct. 20, 1958. 72p.
OTS.

Equipment is described and illustrated for the 105
Metal Examination Facility. The 105 MEF consists of
four water-filled basins and a decontamination area.
Operating instructions are given for the slug breaker,
ultrasonic test equipment, dejacketing equipment, mi-
croscope, camera, weigher, cleaner, etc. (W.D.M.)

2   HW-62099
General Electric Co. Hanford Atomic Products Opera-
tion, Richland, Wash.
REPORT ON HAPO UNITIZED MICROFILM DRAWING
SYSTEM. J Durbin. Oct. 1, 1959. 34p. OTS.

Information and data are reported on the planning and
installation of a new mechanized drawing system which
utilizes a new drawing index system and a 35 mm
microfilm image in a standard IBM card. The planning
required, conversion schedule, costs, savings, and con-
clusions concerning the installation of the unitized
microfilm system at Hanford, including a new Atomic
Energy Commission off-site file of vital drawings for
use in the event of a major Hanford disaster, are pre-
sented. (W.L.H.)

3   ITR-1502
Division of Biology and Medicine, AEC.
THERMAL RADIATION MEASUREMENTS. PARTS I
AND II. Preliminary Report. A. L. Greig and Her-
man E. Pearse. Jan. 1958. Decl. July 30, 1959. 38p.
Project 39.3 [of] OPERATION PLUMBBOB. OTS.

Attempts are reported to obtain records of transient
air temperatures at selected locations in a blast biology
underground shelter during nuclear explosions. No rec-
ords were obtained due to failure of equipment. An eval-
uation of thermal burns was made on Chester White
pigs used as test animals. One pig in the entrance and
one about three feet inside the door received severe
burns, while animals away from the entrance and those
in the slow fill side received no burns. Possible ex-
planations are discussed. (C.H.)

4   SC-2663(TR)
Sandia Corp., Albuquerque, N. Mex.
A METHOD FOR COMPUTING EXPECTED DAMAGE
FROM A SINGLE BOMB. Jan. 14, 1953. Changed from
OFFICIAL USE ONLY Apr. 12, 1956. 31p. OTS.

Numerical methods are presented for computing ex-
pected damage to an arbitrary target by means of a grid
which is to be placed over a scale drawing of the target.
A graphical-numerical method of determining the prob-
ability that the bomb will fall in a given region is briefly
outlined. (W.D.M.)

5   WT-503
Sandia Corp., Albuquerque, N. Mex.
EARTH STRESSES AND EARTH STRAINS. W. R.
Perret. Sept. 15, 1952. Decl. Sept. 29, 1959. 57p.
Operation TUMBLER-SNAPPER. OTS.

Earth pressure and earth strain measurements are
described which were devised to evaluate quantitatively
the effectiveness of soils in attenuating air-shock-
induced earth stresses and to attempt to determine the
magnitudes of accompanying dynamic earth strains.
Results are included from field performance tests of
earth strain gages. A series of supplementary meas-
urements to determine the order of magnitude of ground
accelerations and displacements at small distances
from ground zero is also described. (C.H.)

6   CEA-tr-A-586
RADIOGRAPHIE INDUSTRIELLE À L'AIDE DES RA-
DIOISOTOPES (GAMMAGRAPHIE). COMPARAISON
ENTRE LA RADIOGRAPHIE PAR RAYONS X ET LA
GAMMAGRAPHIE. (Industrial Radiography with the
Aid of Radioisotopes (Gammagraphy). Comparison Be-
tween Radiography With X Rays and Gammagraphy).
O. Werner. Translated into French from Metall 12,
799-802(1958). 22p.

Impressions from a study-trip to the USA are re-
corded. The properties and costs of radioisotopes used
for radiography (Ra^{226}, Cs^{137}, Co^{60}, Ir^{192}) are compared
and discussed. More specifically, they are compared as
to type and energy of radiation, exposure times, shield-
ing needs, installation costs, source costs, and opera-
tion costs. Comparison with x radiation for radiography
is not unfavorable for γ emitters. (T.R.H.)

7
THE SIGNIFICANCE OF POWER PRODUCTION FROM
NUCLEAR ENERGY FOR THE FUTURE REQUIRE-
MENTS OF ITALY. Mario Bruni (La Centrale
Finanziaria Generale S. p. A.) and Agostino Dalla
Verde (Società Idroelettrica Piemonte). Atomwirtschaft
4, 368-73(1959) Sept. (In German)

Because of experience with the construction of hydro-
electric stations in Italy, the high investment costs of
nuclear power stations do not seem to cause unusual
financial problems for private industry. The costs are
a disadvantage, however, as nuclear power stations are
less suitable for peak loads. A comparison of hydro-

electric and nuclear power capacities shows that nuclear power can contribute 6000 Mw of installed capacity to the energy requirements in 1975, provided that nuclear power becomes competitive. (auth)

8

Cl^{36} IN METEORITES. Ch. Gfeller, W. Herr, F. G. Houtermans, and H. Oeschger (Universität, Bern and Max-Planck-Institut für Chemie, Mainz). Helv. Phys. Acta 32, 277-9(1959). (In German)

The Cl^{36} content in the Sichote Alin meteorite was determined. The methods used to separate and count the chlorine are described. An activity of 5.8 ± 0.7 dpm/kg meteorite was obtained. This value corresponds to the value estimated from the argon content. (J.S.R.)

9

ISOTOPIC ANALYSES OF OSMIUM FROM IRON METEORITES AND TERRESTRIAL SAMPLES. W. Herr and E. Merz (Max-Planck-Institut für Chemie, Mainz) and J. Geiss, B. Hirt, and F. G. Houtermans (Physik. Institut der Universität, Bern). Helv. Phys. Acta 32, 282-4(1959). (In German)

The osmium was extracted from meteorite samples and from minerals and standard Merck samples. The isotopic ratio was determined mass spectrographically and the Os^{187}/Os^{186} ratios are tabulated. The Os^{187}/Os^{186} ratio in the Os^+, OsO_2^+, OsO_3^+, and OsO_4^+ ion beams were determined for a meteorite, mineral, and Merck sample. The results are tabulated. (J.S.R.)

10

UNDERGROUND NUCLEAR DETONATIONS. G. W. Johnson, G. H. Higgins, and C. E. Violet (Univ. of California, Livermore). J. Geophys. Research 64, 1457-70(1959) Oct.

Since 1952 eight nuclear explosions have been fired underground at the Atomic Energy Commission's Nevada Test Site. The explosions varied in energy release from 55 tons to 19,000 tons of TNT equivalent. Depths of burial varied from shallow, to produce cratering, to deep, where no visible effects appeared on the surface. The major experimental data from these explosions, as well as the phenomenology of the deeper shots, are summarized here. (auth)

11

AMPLITUDES OF SEISMIC BODY WAVES FROM UNDERGROUND NUCLEAR EXPLOSIONS. Carl Romney (Air Force Technical Applications Center, Washington, D. C.). J. Geophys. Research 64, 1489-98(1959) Oct.

Seismic waves from underground nuclear explosions in Nevada were observed at a number of temporary stations along a line extending eastward to Maine. A study of the seismograms from these stations and from a large number of permanent stations has shown that the amplitude of Pn varies inversely as the cube of the distance between 200 and 1100 km. Pn then disappears and a late-arriving higher velocity wave appears with relatively large amplitude. This later P wave has a slight amplitude maximum at about 2000 km, after which it decreases irregularly with distance. Between 200 and 2000 km the amplitude of S (or Lg) varies inversely as the cube of the distance. The vertical, radial, and transverse components are of approximately equal size, and are about three times the amplitude of Pn between 200 and 1000 km. At distances of 100 km or more the amplitudes of the body waves are proportional to the first power of the explosive yield. The explosions produced seismic waves equivalent in size

to those from natural earthquakes of magnitude: M = 3.65 + log Y, where Y is the energy of the explosion expressed in kilotons of TNT equivalent. (auth)

12

IRRADIATION SERVICES AT WANTAGE. PROTOTYPE COMMERICAL PLANT NEARS COMPLETION. Nuclear Power 4, No. 42, 110-11(1959) Oct.

The design of a plant to provide continuous irradiation of industrial products is reported. This plant will be used to sterilize medical products and small quantities of experimental materials, and bring about cross-linking in polyethylene. A dose on the order of 2.5 rads is given each package at a flow of 234 to 28,080 packages per hour. The 150,000-c cobalt-60 source will provide 7 megarad tons of irradiated products per day. The operating mechanisms are hydraulically powered and electronically controlled to give uniform treatment with maximum source utilization. (C.J.G.)

13

DIE INGENIEURAUSBILDUNG IN DER SOWJETUNION. (Engineer Training in Soviet Union). Margot Lerch. No. 2 of "Schriftenreihe des Bundesministers for Atomkernenergie und Wasserwirtschaft. Forschung und Bildung." Celle, Ger., Pohl—Druckerei und Verlagsanstalt, 1958. 74p. DM 4.

The essential results of a British study "Engineering Education in the Soviet Union" are summarized. The status of academic and non-academic education, the educational capacity of the technical schools, and the curriculum of the schools are described. The significance of the report with respect to engineering education in Germany is discussed. (J.S.R.)

BIOLOGY AND MEDICINE

General and Miscellaneous

14   UCRL-8705

California. Univ., Berkeley. Lawrence Radiation Lab. BIOLOGY AND MEDICINE SEMIANNUAL REPORT [FOR] OCTOBER 1958 THROUGH MARCH 1959. May 1959. 69p. Contract W-7405-eng-48. OTS.

Data are presented from a series of studies on radiation effects on protein solutions. Data are included on radical-combination reactions in the radiolysis of protein-$CH_3C^{14}OOH$ solutions; the production of carbonyl bonds in the radiolysis of aqueous proteins; the production of amide groups and ammonia in the radiolysis of aqueous proteins; and the irradiation of peptides in the solid state. High-energy protons and alpha particles from the 184-inch cyclotron were used for pituitary irradiation. One hundred three patients have been irradiated. Most of these patients had metastatic mammary carcinoma, and promising effects have been shown on patients with this and various pituitary and hormonally dependent diseases. Peak doses of 14,000 to 30,000 rad have been delivered to the center of the pituitary. At the higher hypophysectomizing dose level, decreased pituitary function and marked gross and microscopic damage to the pituitary have been demonstrated. Decrease in pituitary function and the consequent effects on the target and organs were manifested in depression of the thyroid iodine[131] uptake and decrease in 24-hour pituitary gonadotropins, urinary steroids, and estrogen excretion. These correlated well with clinical evidence of hypopituitarism. The bio-

logical effects of heavy ion beams were studied in yeast, bacteria, and in enzyme preparations exposed in vacuum. E. coli when grown anaerobically with glucose normally causes the medium to become acid. It was found here that if this growth is forced to occur under alkaline conditions the protection of anaerobic growth disappears, independently of the gas present during irradiation. It thus seemed probable that protection by anaerobic growth was independent of the "oxygen effect" known to occur during irradiation. Aerobic growth at different pH values caused no differences in radiosensitivity. Cytological and nucleic acid determinations demonstrated that anaerobic-acid conditions produce multinucleate cells of E. coli, while anaerobic-alkaline-grown cells have fewer nuclei per cell. Thus the resistance conferred by anaerobic growth of this organism can be attributed to a multiple-hit requirement (according to classical target theory), rather than to intracellular oxygen depletion as assumed by previous workers. Iron-59 was used to study 35 patients with a wide variety of blood disorders. Phosphorus-32 was used in red cell volume determinations. Ten patients with anemia, leukopenia, or thrombocytopenia were studied with P^{32} diisopropylfluorophosphonate. The results of these studies were correlated with the clinical course, routine hematologic studies, and iron kinetic studies. Carbon-14 labeled glucose and uric acid were used in tracer studies on intermediary metabolism in normal subjects and diabetic patients. Preliminary results indicate that uric acid is not entirely an end product of metabolism, since approximately 10 to 15% of the compound is oxidized within the body to carbon dioxide. Orinase and DBI, two of the new oral compounds that lower blood sugar, were found to resemble insulin in that they decrease endogenous hepatic release of glucose from glycogen but, unlike insulin, they do not appreciably increase glucose oxidation. Cardiac output and blood volume were measured with I^{131}-labeled albumin in patients with polycythemia or anemia. A new method involving external measurements of heart radioactivity was compared with the established method of measuring radioactivity of blood obtained by arterial cannulation. Preliminary results indicate that cardiac output may be accurately determined by external measurement over the heart without arterial puncture. Cobalt-60 labeled vitamin B_{12} was used in absorption tests in the differential diagnosis of pernicious anemia. Gastrointestinal bleeding was detected and quantiated in patients by collection of stool specimens for a period of four weeks and measuring the amount of iron-59 labeled red blood cells present. Iodine-131 thyroid uptake and body scans were continued as a semiroutine study in 25 patients. Progress is reported in an evaluation of activation-analysis for studies of the elemental composition of blood. Design features are described of an analog model to illustrate a homeostatic mechanism accounting for the physiological regulation of body fluid volume. A pump circulates the fluid through an ion-exchange resin, which removes dye from the fluid. This corresponds to the removal of antidiuretic hormone from the blood by the liver. Data are summarized from the following: tracer studies on cardiovascular functions; the determination of serum protein-bound iodine; urinary estrogen excretion in patients with advanced metastatic mammary carcinoma; the relationship between atherosclerosis and lipoproteins; the physical chemistry of lipoproteins; and factors that modify the effects of densely ionizing radia-

tions on yeast. The design is reported of a positron camera which employs a new principle for obtaining images of the distribution of positron-emitting isotopes in a human or other subject. Routine activities in health chemistry and health physics are summarized. A list of papers and reports prepared during the period is included. (For preceding period see UCRL-8513.) (C.H.)

15　　　　　　UCSF-19

California. Univ., San Francisco. School of Medicine. Radiological Lab.
A REVIEW OF THE LABORATORY'S ACTIVITIES AND PROGRAM. Progress Report for Period Ending July 31, 1959. Sept. 1959. 47p. Contract AT-11-1-GEN-10, Project No. 2. OTS.

Clinical results are summarized for 109 patients with advanced cancer treated with 70-Mv x rays from the synchrotron. Advantages of 70 Mv x rays for cancer therapy are discussed. Problems and activities associated with the installation, operation, and dosimetry of a 70-Mev synchrotron are reviewed. Results are summarized from a series of studies on the relative biological effectiveness of various x-ray and electron beams of clinical interest on biological materials. Four kinds of bacteria, two kinds of yeast, the chick embryo, the mouse testis, and the mouse LD_{50} were employed in a standardized series of tests carried with a 1-Mvp x-ray beam and with a 70 Mvp synchrotron x-ray beam. Results are tabulated from interlaboratory comparisons of data. Data are included from studies on the acute radiation syndrome and the effects of dose fractionation on response. Results are summarized from a series of studies on factors that influence the x-ray sensitivity of microorganisms and mammals. Data are included from studies on the late effects of radiation in laboratory animals and man, including certain genetic aspects of the problem. A list is included of papers presented at meetings and publications during the period. (C.H.)

16　　　　　　UCRL-Trans-494

THE USE OF RADIOISOTOPES IN MEDICINE. A Bibliography. Translated by Maria Kassatkin (Univ. of California) from Russian reference cards. 22p. JCL or LC.

A compilation of reference cards translated from Russian is presented. 208 references are included. (J.R.D.)

17

EFFECTS OF STABLE CALCIUM AND STRONTIUM ON DEPOSITION OF CALCIUM-45 AND STRONTIUM-89 IN BONE. B. Kawin (Hanford Labs., Richland, Wash.). Experientia 15, 313-14(1959).

The effect of single doses of stable calcium and strontium carrier on the deposition of calcium-45 or strontium-89 in bone was investigated in rats. Data are tabulated and results are discussed. (C.H.)

18

AUTORADIOGRAPHY OF SMEARS OF PERIPHERIC BLOOD AS A METHOD OF EARLY RECOGNITION OF INNER IRRADIATION WITH RADIOACTIVE SUBSTANCES. A. A. Danilin, Z. N. Kozyrina, E. I. Shcherban', and E. S. Khachkuruzova. Zhur. Nauch. Priklad. Fot. i Kinematografii 4, 289-91(1959).

A method of blood autoradiography is presented. A thin smear containing radioactive blood is prepared on a clean slide. The dried smear is fixed by methyl alcohol. A sublayer of 1% celiodine solution is added to the fixed blood smear, after which liquid photographic

emulsion is spread over the smear. The exposed preparation is treated for 3 to 4 minutes in amidol developer and fixed with 40% hyposulfite. The smear is dyed after the radioautography has dried. The dyed preparation is covered with lacquer. (TCO)

19

DYNAMICS OF CELL PROLIFERATION AND ISOTOPE INCORPORATION INTO DEOXYRIBONUCLEIC ACID. Demetrios A. Rigas. p.408-30 of "The Kinetics of Cellular Proliferation." New York, Grune and Stratton, Inc., 1959.

The dynamics of cell proliferation in the nonsteady and steady state have been theoretically analyzed. It is shown that when the proliferation characteristics remain constant the number of cells changes exponentially, and the ratio of the cells destined to divide to those destined to die remains constant. It is concluded that mere observation of an exponential increase of the number of cells is insufficient evidence for excluding cell death. The theoretical analysis of the kinetics of isotope incorporation into the DNA indicates that the method is suitable for the determination of the distribution and the mean of the life span and of the generation time of cells that are either in a steady state or show an exponential change in number. The complexity, however, of the equations of the generalized nonsteady state makes the use of this method, as well as any other indirect method, quite impractical. The use of the equations, particularly in reference to their application in the study of the hemopoietic system, as well as the limitations of the method have been discussed. (auth)

Biochemistry, Nutrition, and Toxicology

20 AECU-4433

Michigan State Univ., East Lansing.
FOLIAR ABSORPTION OF MINERAL NUTRIENTS WITH SPECIAL REFERENCE TO THE USE OF RADIO-ISOTOPES AND THE "LEAF WASHING TECHNIQUE" (thesis). Woon Heng Jyung. 1959. 54p. OTS.

Foliar absorption rates for phosphorus-32 and calcium-45 in beam plants were determined. (C.H.)

21

RADIOIODINE UPTAKE MEASUREMENT. Marshall Brucer (Oak Ridge Inst. of Nuclear Studies, Tenn.). Acta Radiol. Interamericana 7, 129-43(1959).

The variation in thyroid uptake measurements among laboratories is due to the use of different combinations of standards, instruments, distances, techniques, and formulas. The need for a calibration program is stressed. Techniques used in physical measurements are described and discussed. (C.H.)

Fallout and Radiation Ecology

22 NRL-5359

Naval Research Lab., Washington, D. C.
MEASUREMENTS OF THE AIR CONCENTRATION OF GROSS FISSION PRODUCT RADIOACTIVITY DURING THE IGY JULY 1957–DECEMBER 1958. L. B. Lockhart, Jr., R. L. Patterson, Jr., and W. L. Anderson. June 12, 1959. 18p.

Measurements of the gross fission product radioactivity in the air at 21 sites along the 80th meridian and 4 sites in the North Pacific area are reported for the period July 1957 to December 1958. The activity levels at the various sites are related both to the stratospheric deposition of nuclear debris and to the direct introduction of radioactive material into the troposphere upwind of the collecting sites. The fission product radioactivity of the air of the Northern Hemisphere increased markedly as the result of the extensive series of tests carried out during this period. Fission products, however, still contribute only a small fraction of the total radioactivity of the ground-level air. Radioactive debris injected into the troposphere at any particular site spreads rather rapidly throughout the same hemisphere but rarely crosses the equator in any quantity. An exception of this occurred during the Hardtack series in the Pacific when massive quantities of activity were transported to the Southern Hemisphere by winds in the upper troposphere. It is again shown that periods of heavy rainfall, such as occur during the rainy season in Panama, cause a general decrease in the concentration of fission products in the air. (auth)

23

ATMOSPHERIC RADIOACTIVITY LEVELS AT YOKOSUKA, JAPAN, 1954-1958. Luther B. Lockhart, Jr. (Naval Research Lab., Washington, D. C.). J. Geophys. Research 64, 1445-9(1959) Oct.

Measurements made on the concentrations of some natural radioactive materials and gross fission products in the air at ground level at Yokosuka, Japan, during the period 1954 to 1958 are reported. The concentrations of both natural radioactive products and fission products in the air at ground level vary widely from time to time. The change in the concentration of the natural radioactivity is related in a general way to the phenomena that control precipitation. The trend of the fission-product concentration has been upward during the past few years as a result of increasing nuclear testing. (auth)

24

ON THE RADIOACTIVITY FOUND IN THE WESTERN SUBURB OF HIROSHIMA AFTER THE EXPLOSION OF AN ATOMIC BOMB. Fumio Yamasaki. J. Sci. Research Inst. (Tokyo) 46, 59-67(1952) June.

A few days after the explosion of an atomic bomb at Hiroshima, samples of sand and mud were collected in various parts of the city and analyzed for gross radioactivity and uranium fission products. Data are tabulated. (C.H.)

25

RADIOACTIVITY OF ATMOSPHERIC PRECIPITATION. B. I. Styro. Nauch. Soobshcheniya Inst. Geol. i Geograf. Akad. Nauk Litovskoĭ S.S.R. 2, 5-54(1955). (Translated from Referat. Zhur. Geograf., No. 6, 1957, p.53).

The study offers a comprehensive review of the literature on the radioactivity of atmospheric precipitation. Results of an experimental study on the radioactivity of precipitation are presented. Samples of precipitation were collected in special flat metal vessels with variable size of collecting surfaces. Geiger-Muller light-gauge counter facilitated radioactive measurement of the samples and of the post-evaporative residue. Actual decomposition curves of radioactive substances present in rain water were analyzed by being compared with the theoretical curves. The article includes the explanation of theory used in calculation of theoretical curves. The experiments showed that dissolved Rh-RaA, RaB, and RaC are usually present. Moreover, an active supplementary component was detected, which appar-

ently belongs to Na^{24} u Ar_8^{41}. The method of least squares was used to determine constants of decomposition of radioactive substances in the atmospheric precipitation. A bibliography of 52 titles is included.

26

RADIOACTIVITY OF ATMOSPHERIC PRECIPITATION. B. I. Styro. Nauch. Soobshcheniya Inst. Geol. i Geograf. Akad. Nauk Litovskoi S.S.R. 2, 63-72(1955). (Translated from Referat. Zhur. Geograf., No. 6, 1957, p.53).

The assertion is made that cloud drops acquire their radioactivity by a purely electrical means, and that the mechanics of this process are similar to activating a negatively charged ground wire. The speed at which atoms settle on cloud drops under stationary conditions is determined by the equation:

$$\frac{dm_A}{dt} = \alpha \frac{\lambda E}{\lambda A} N_E \frac{n-\bar{q}}{m},$$

where m_A is specific atom concentration on drops, a is the probability of capturing of RaA atoms by a drops, $n^-\bar{q}/m$ is specific negative charge of cloud particles, N_E is Rn concentration in a single cloud unit, λ_E is the Rn decomposition constant, λ_A is the RaA decomposition constant. This formula can be rewritten as: $\Delta I_o = \alpha(n^-\bar{q}/m) N_E \phi$, where $\phi = \phi(\lambda A, \lambda B, \lambda C, \lambda E, t, T)$ is a nondimensional coefficient depending upon decomposition constants, the time needed by the sample to be formed in the cloud, T, and the time needed to complete the determination, t; ΔI is the number of decompositions occurring in one minute as recorded by a counter. Using information obtained by studying radioactivity of the cloud masses, it has been calculated that $\alpha = 3.8 \times 10^{-2}$ $cm^{3/2}/g^{1/2}$. The author has also considered whether it is possible to determine the coefficient of a vertical turbulent exchange from data on cloud radioactivity, obtained under stationary conditions by means of the formula:

$$K_z = \frac{\lambda_E \Delta I_o hm}{\alpha \phi \bar{\rho}} \cdot \frac{1}{n^-\bar{q}} \cdot \frac{1}{dN_E/dz'}$$

where K is the coefficient of vertical turbulent exchange dN_E/dz is the vertical gradient of emission concentration, h is vertical cloud thickness, $\bar{\rho}$ is average atmospheric density. When calculated by this formula, K_z falls between 4 and 17 m^2/second. Other investigators reported that, under the same conditions, K_z falls between 4 and 75 m^2/second.

27

γ-RAY SPECTROSCOPY OF ARTIFICIAL RADIONU-CLIDES COLLECTED BY AIR FILTRATION AT THE GROUND. G. Aliverti (Istituto Universitario Navale, Naples); F. Demichelis (Istituto di Fisica Sperimentale del Politecnico, Turin); and G. Lovera (Università, Modena, Italy). Nuovo cimento (10) 13, 453-5(1959) July 16.

Gamma spectroscopy of artificial radionuclides collected by air filtration at the ground revealed a considerable increase of the relative intensity of the 0.75 Mev peak of the Zr-40 and Nb-41 γ rays. The values of energies corresponding to observed prominent peaks of nuclides presumed responsible for γ rays for the period March 11 through April 24, 1959, are tabulated. (C.J.G.)

28

THE ARTIFICIAL RADIOACTIVITY IN RAIN WATER OBSERVED IN JAPAN FROM MAY TO AUGUST 1954. Y. Miyake (Meteorological Research Inst., Tokyo). Papers Meteorol. and Geophys. (Tokyo) 5, 173-7(1954) Sept.

Data are summarized on levels of radioactivity in samples of air-borne dust and rain water collected in Japan following the thermonuclear weapons tests at Bikini atoll from March to May 1954. (C.H.)

Radiation Effects on Living Tissues

29   BNL-4296

Brookhaven National Lab., Upton, N. Y. RADIATION-INDUCED SOMATIC MUTATIONS IN PLANTS. A. H. Sparrow and R. L. Cuany. [1959?] 10p. OTS.

Data are presented which relate somatic mutations to both acute and chronic exposures of ionizing radiation. These data lead to the conclusion that if the somatic mutations observed are primarily the result of deficiencies, these must be small enough to permit adequate survival of the mutant cells. The maximum yield of these mutations is obtained from high intensity exposure. It appears that radioinduced somatic mutations may be a valuable source of variation. (J.R.D.)

30   CEA-912

France. Commissariat à l'Énergie Atomique, Paris. ÉTUDES SUR LES EFFETS A DISTANCE DANS LES ORGANISMES MULTICELLULAIRES IRRADIÉS. (Study of Abscopal Radiation Effects on Multicellular Organisms). Frédéric Ludwig. Dec. 1958. 44p.

Among the lesions brought about by total body irradiation, two basically different types can be distinguished: those appearing in the area which has absorbed radiant energy and those emerging in areas remote from the irradiated tissues (abscopal effects). The abscopal effects are produced by tissue breakdown products, which are removed by the bloodstream and interfere with particularly sensitive structures (radiotoxins). The radiotoxins mobilize other biologically active substances, interfering with the same tissues which may display abscopal effects. This is well established for the hormones of the adrenal cortex. Furthermore, important fractions of the radiotoxins are neutralized by the reticulo-endothelial system. Temporary blockage of this system enhances the efficiency of radiotoxins and greatly increases mortality of the irradiated animals. One can therefore conclude that the reticuloendothelial system affords a natural defense against an essential reaction of total body irradiation: the effect of the radiotoxins. (auth)

31   USNRDL-TR-345

Naval Radiological Defense Lab., San Francisco. FURTHER STUDIES IN RADIATION CONDITIONED BEHAVIOR. I. SOME FACTORS WHICH INFLUENCE RADIATION CONDITIONED BEHAVIOR OF RATS. II. RADIATION INDUCED CONDITIONED AVOIDANCE BEHAVIOR IN RATS, MICE AND CATS. III. CONDITIONED AVOIDANCE BEHAVIOR INDUCED BY LOW DOSE FAST NEUTRON EXPOSURE. J. Garcia and D. J. Kimeldorf. July 28, 1959. 37p.

Learned avoidance behavior in animals resulting from an association of radiation exposure and taste cues was investigated. It was found that localized x-ray exposure of the head, thorax, abdomen, or pelvis could serve as a motivating stimulus to condition a saccharin aversion in rats. The abdomen proved to be a region of special sensitivity although the response was not as pronounced as that following total-body exposure for the same dose. Neither adrenalectomy or hypophysectomy prevented the development of the conditioned saccharin aversion

following total-body exposure. It is suggested that sensations triggered by gastric dysfunction may represent the stimuli through which radiation acts to condition behavior in animals. The development of a conditioned aversion toward a taste stimulus associated with radiation exposure is not limited to the rat. It was found that such learning can also be demonstrated with mice and cats. The phenomenon was manifested by a progressive reduction in the amount of flavored fluid consumed during a series of x-ray exposures and subsequently by a decrement in preference for the test fluid in the absence of exposure although other fluids were readily ingested by the animal. Fast neutrons as well as gamma or x rays can act as a stimulus to condition such behavior in rats. A total-body neutron dose of 7.5 rads was sufficient to alter the preference for saccharin. Furthermore, in contrast to previous studies, which employed radiation exposures of several hours at low-dose rates, the neutron exposure lasted only a few minutes, indicating that the conditioning can be obtained under a wide variety of dose rates and exposure conditions. (auth)

32 SCL-T-275

GRAFTING OF HEMATOPOIETIC CELLS. (La Greffe de Cellules Hematopoietiques). G. Mathé and J. Bernard. Translated by Marcel I. Weinreich (Sandia Corp.) from Rev. franç. études clin. et biol. 3, 943-4 (1958). 4p. JCL.

Observations are described on the response of mice to intravenous injections of homologous or heterologous medullar cells administered following irradiation at the $LD_{100/30}$ range. Reaction mechanisms involved in the host response are discussed. (C.H.)

33

IMPLICATIONS OF SPACE RADIATION IN MANNED SPACE FLIGHTS. Wright H. Langham. Aerospace Med. 30, 410-17(1959) June.

Present physical measurements of ionizing radiations in space suggest two major potential radiobiologic problem areas in manned space flight. The first concerns the biologic effects of densely ionizing heavy primary cosmic ray particles, and the second concerns the effects of the particulate radiation belts, the so-called Van Allen layers, associated with the earth's magnetic field. Data on the acute, chronic, and delayed effects of radiation on man are reviewed. Available data on the heavy primary cosmic rays and on Van Allen radiation are summarized. The question of acceptable levels of radiation risk in manned space flight is discussed. Maximum permissible levels of radiation exposure in industry are reviewed. The author concludes that application of these criteria to the early phases of manned space flight seem unrealistically conservative. (C.H.)

34

KETOGENESIS BY LIVER SLICES FROM FASTING RATS EXPOSED TO X-IRRADIATION. Joseph A. Ontko (School of Aviation Medicine, Austin, Tex.). Arch. Biochem. Biophys. 84, 243-4(1959) Sept.

Liver slices from fasting rats exposed to x radiation demonstrated a decreased production of ketone bodies. (C.H.)

35

EXOSMOSIS FROM PLANT CELLS AFTER X-IRRADIATION. I. M. Vasil'ev, Tsien Su Iun, and N. D. Rybalka (Academy of Sciences, USSR, Moscow). Biophysics 5, 544-8(1959) June.

General and electrolyte exosmosis from wheat seedlings are used to show that doses of 0.3, 1, 3, 5, 20, and 30 kr scarcely influence exosmosis; exosmosis is much increased by stored materials not used up in growth; and material stored as the osmotically active content of vacuoles is not exosmosed. (auth)

36

EFFECTS ON THYROID OF RAT IRRADIATED BY HIGH-ENERGY PARTICLES FOCUSSED ON THE HYPOPHYSIS. Paul Blanquet (Laboratoire de Physique, Bordeaux). Compt. rend. 249, 1064-6(1959) Sept. 21. (In French)

The irradiation of the hypophysis of particles accelerated to high energy (α or deuterons) and focused at its level, causes modifications of thyroidal metabolism analogous to those observed in surgically hypophysectomized animals. (tr-auth)

37

EFFECTS ON RAT THYROID OF IRRADIATION OF THE ANTERIOR HYPOTHALAMUS WITH FOCUSSED HIGH-ENERGY PARTICLES. Paul Blanquet (Laboratoire de Physique, Bordeaux). Compt. rend. 249, 1151-3(1959) Sept. 28. (In French)

The irradiation of the anterior hypothalamus by particles accelerated to high energies (α or deuterons), and focused at its level, leads to thyroidal metabolism changes. Although the thyroidal supply of I^{131} remains normal, the intra-thyroidal (and circulating) concentration of hormones diminishes notably. (tr-auth)

38

THE RESTORATION OF RAY DAMAGES OF CHROMOSOMES, INDUCED BY VARIOUS CHEMICAL AGENCIES. L. S. Zarapkin (Inst. of Biology, Ural Branch of the Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 128, 190-3(1959) Sept. 1.

Specific effects of cysteine on the rate of restoration of chromosomes are analyzed and the mechanism of the process is described. Experiments were carried out with dried peas irradiated with 15,000 r of γ rays from Co^{60} and soaked for 4 to 6 hours in 0.01 M solutions of cysteine, sodium chloride, ethyl alcohol, and acetic acid, followed by soaking in water for 18 to 20 hours. The influence of various substances on the mitotic activity and the type and percentage of abnormal aphanase at various fixation points are tabulated. (R.V.J.)

39

INDUCTION OF MULTIPOLAR SPINDLES BY SINGLE X-IRRADIATED SPERM. R. C. Rustad (Florida State Univ., Tallahassee). Experientia 15, 323-4(1959).

A simple method was devised to provide a highly independent and statistically significant test of whether or not the x-ray-induced multipolar spindles in sea urchin eggs arise from polyspermy. Results indicate that multipolar spindles are formed following x irradiation of sperm and are not a polyspermy effect. (C.H.)

40

PHOTOREACTIVATION OF BACTERIA IRRADIATED WITH X-RAYS. F. Herčík (Czechoslovak Academy of Sciences, Brno). Folia Biol. (Prague) 3, 31-6(1957).

41

EARLY CYTOLOGICAL CHANGES IN THE LYMPHOCYTE AND MYELOID COMPONENTS OF MOUSE SPLEEN FOLLOWING X-RAY IRRADIATION. M. Praslička and M. Hill. Folia Biol. (Prague) 3, 37-48(1957). (In Russian)

Cytological changes in the spleen of mice are de-

scribed which were observed after whole-body exposure to 500 r x radiation. Observations are compared with histological changes following irradiation with a dose of 500 r in mice narcotized with ether, ethanol, chloral hydrate, or sodium luminal. All the narcotics retarded the onset of disintegration of the lymphocytes and slowed down injuries observed in the controls. Possible explanations are discussed. (C.H.)

42

THE EFFECT OF X-RAY IRRADIATION ON ANIMALS WITH LIVER DAMAGE. M. Skalka (Inst. of General Biology, Brno). Folia Biol. (Prague) 3, 246-51(1957).

The role of the liver in the radiation syndrome was investigated. It was shown that rats with chemically-damaged livers were more sensitive to x rays than were animals with normal livers. (C.H.)

43

SPERMATOGENESIS IN RATS FOLLOWING IRRADIATION DURING EMBRYOGENESIS. A. Lengerová and M. Vojtíšková (Czechoslovak Academy of Sciences, Prague). Folia Biol. (Prague) 3, 282-5(1957).

Data are summarized from a study of the effects of irradiation during embryonic development in mice. A single exposure of 200 r was used on the 7th, 11th, or 15th day of gestation. The testes were subjected to histological examination when the animals reached six weeks of age. Findings are reported. (C.H.)

44

COSMIC RAYS AS A FACTOR IN CYTOLOGICAL PROCESSES IN HORDEUM. M. Sosna (Czechoslovak Academy of Sciences, Prague). Folia Biol. (Prague) 3, 308-13(1957).

Data are summarized from a study of the effects of cosmic radiation as a whole, and of the independent components, on mitotic division of nuclei in the root meristem of barley. The experimental conditions permitted the control of all factors. It was concluded that a demonstrable relationship exists between cosmic radiation and the course of mitotic division of cells of the root meristem. (C.H.)

45

GROWTH DISTURBANCES OF THE SKELETAL SYSTEM BY A RADIOINDUCED MYXEDEMA. Bernard Freyer (Städtischen Rudolf-Virchow-Krankenhaus, Berlin). Fortschr. Gebiete Röntgenstrahlen u. Nuklearmed. 91, 305-11(1959) Sept. (In German)

A case of infantile myxoedema with growth disturbances of the entire skeleton following irradiation of a vocal cord papilloma is described. The radio-therapeutic effects following treatment of laryngeal papillomatosis are mentioned. (auth)

46

EARLY REACTIONS IN BLOOD PICTURE OF X-IRRADIATED RABBITS AFTER SUBLETHAL AND COMBINATION EXPOSURES. I. Boll, R. D. Meyer, and J. Trautmann (Städt. Krankenhaus Moabit, Berlin). Fortschr. Gebiete Röntgenstrahlen u. Nuklearmed. 91, 316-28(1959) Sept. (In German)

In order to examine the early changes in the blood following combined courses of radiation, rabbits were exposed to 1 r, 2 r and 4 r for 100 consecutive days and finally were given 100 r or 200 r in single doses. In addition, the response to single total body radiation of 25 - 200 r was tested. The shift of reticulocytes and white blood corpuscles was described during the original small-dose irradiation and particularly after major

irradiation for a period of 48 hours. Following total body radiation with 100 r and 200 r we found a brief granulocytic phase proportional to dose lasting 1-6 hours, together with a longer lymphopenic period. Small-dose pre-irradiation prevented the granulocytic reaction after 100 r but not after 200 r. Lymphopenia was a sign of real cell damage and became increasingly severe and protracted with increasing dose. Reticulocyte counts showed no significant changes within 48 hours. (auth)

47

RADIOSENSITIVITY. Irwin I. Oster (Indiana Univ., Bloomington). Genen en Phaenen 3, 53-66(1958).

The condensed state of the chromosomes of many organisms is the most sensitive to x rays. A comparison of the radiosensitivity of Drosophila melanogaster spermatids and spermatozoa, both having condensed chromosomes, indicated that some other factor(s) is responsible, in part at least, for the greater sensitivity of the former cells. X irradiation of mature sperm and spermatids in either nitrogen, air, or oxygen which indicated a relatively greater effect of reducing the oxygen tension and a relatively lesser effect of increasing the oxygen tension from that present in air on the radiosensitivity of spermatids as compared to spermatozoa lends support to the suggestion that the high sensitivity of spermatids may at least in part be due to more intra- and/or inter-cellular oxygen being normally present (or available) in these cells. It would be of interest to determine whether such a mechanism can account for the variations noted in the radiosensitivity of other chromosomes having otherwise similar morphological properties. (auth)

48

EFFECTIVENESS OF TRANSFUSIONS OF FRESH AND LYOPHILIZED PLATELETS IN CONTROLLING BLEEDING DUE TO THROMBOCYTOPENIA. Dudley P. Jackson, Dale K. Sorensen, Eugene P. Cronkite, Victor P. Bond, and Theodore M. Fliedner (Brookhaven National Lab., Upton, N. Y. and Johns Hopkins Univ. and Hospital, Baltimore). J. Clin. Invest. 38, 1689-97 (1959) Oct.

Eight dogs were rendered thrombocytopenic by the administration of 500 to 550 r whole-body irradiation. After thrombocytopenia developed, the thoracic duct of each dog was cannulated and large numbers of red blood cells were observed in the thoracic duct lymph. The hemostatic effectiveness of fresh and lyophilized platelets in reducing the output of red blood cells in the lymph was compared. Lyophilized dog platelets were infused into each dog in amounts calculated to increase the recipient's platelet level by approximately 200,000 per cu mm. The circulating platelet levels of the recipients did not increase following infusions of lyophilized platelets, and the output of red blood cells in the lymph did not decrease significantly. Five of the dogs also received infusions of freshly separated, viable platelets. Fresh platelets were administered after the administration of lyophilized platelets in four of the animals, and in one the fresh platelets were administered initially. The circulating platelet levels of the recipients increased following infusions of fresh platelets, and the output of red blood cells in the lymph decreased strikingly. (auth)

49

SUPERLETHAL WHOLE BODY IRRADIATION AND ISOLOGOUS MARROW TRANSPLANTATION IN MAN.

E. Donnall Thomas, Harry L. Lochte, Jr., Joe H. Cannon, Otto D. Sahler, and Joseph W. Ferrebee (Mary Imogene Bassett Hospital, Cooperstown, N. Y.). J. Clin. Invest. 38, 1709-16(1959) Oct.

Leukemia has been studied in two sets of identical twins. One leukemic twin was irradiated with 850 r and the other with 1,140 r from Co⁶⁰ sources. Each was then given bone marrow from the respective normal twin. Successful transplantation of this isologous marrow was determined by the return of marrow function, evident after less than two weeks, and by a benign clinical course following radiation. Leukemia recurred after remissions of seven weeks in one case and 12 weeks in the other. From these two patients it was concluded that transplants of isologous marrow are readily achieved in man; one thousand r of whole-body radiation does not produce troublesome acute radiation sickness in man when given at a rate of 20 to 40 r per hour; whole-body irradiation at the 1,000 r level produces a remission but not a cure of leukemia when followed by isologous marrow. (auth)

50

AN EXPERIMENT ON THE GROUPING OF GENE MUTATIONS IN DROSOPHILA MELANOGASTER. Yoshio Nishina and Daigoro Moriwaki. Japan. J. Genet. 17, No. 4, 171-4(1941) Aug.

Preliminary results are reported from a study of radioinduced lethal mutations in Drosophila melanogaster. (C.H.)

51

INFLUENCE OF UNBALANCED GROWTH ON SUBSEQUENT X-RAY-INDUCED INHIBITION OF DEOXYRIBONUCLEIC ACID SYNTHESIS IN ESCHERICHIA COLI 15$_T$. Daniel Billen (Univ. of Texas, Houston). Nature 184, 174-6(1959) July 18.

The influence of unbalanced growth on subsequent radiation induced inhibition of desoxyribonucleic acid synthesis in Escherichia coli was investigated. Results are presented which show an inhibition by chloramphenicol of phasing or synchronization of the desoxyribonucleic acid-synthesizing system and that the radiosensitivity of the synthesizing mechanism is altered by previous chloramphenicol exposure. (C.H.)

52

FREE RADICALS IN X-RAYED SEEDS OF HIGH AND LOW WATER CONTENT, AS MEASURED BY ELECTRON SPIN RESONANCE. W. Klingmüller, G. R. Lane, M. C. Saxena, and D. J. E. Ingram (Univ. of Southampton, Hampshire, Eng.). Nature 184, Suppl. 7, 464-5 (1959) Aug. 8.

The free-radical content of Vicia faba seed x irradiated to 10,000 r at 250 kv was studied. The results indicate a correlation between x-ray sensitivity as measured by biological damage and radioinduced free radicals. (T.R.H.)

53

CONTRIBUTION TO THE KNOWLEDGE OF THE PROTECTIVE ACTION OF HEMOPOIETIC TISSUE TRANSPLANTED IN IRRADIATED ANIMALS. U. Torelli, M. Malavolti, and T. Artusi (Istituto di Patologia Medica, Modena, Italy). Panminerva med. 1, 10-13(1959) May.

Results are reported from a series of studies on the effects of rat bone marrow suspensions on lethally irradiated mice. Results indicate that rat bone marrow exercised a decided protective effect. Modifications

in the lymphocyte levels and factors affecting the development of delayed heterologous reactions are discussed. (C.H.)

54

GENETIC RADIATION DAMAGE REVERSAL BY NITROGEN, METHANE, AND ARGON. Tsueng-Hsing Chang, Florence D. Wilson, and Wilson S. Stone (Univ. of Texas, Austin). Proc. Natl. Acad. Sci. U. S. 45, 1397-1404(1959) Sept.

The oxygen effect, leading to increased radiation damage, can be countered or prevented to a large degree by the addition of 9 atmospheres of argon, nitrogen, or methane to 1 atmosphere of air or oxygen during irradiation. On the other hand, the addition of 9 atmospheres of carbon monoxide to 1 atmosphere of air increases the radiation damage. These findings apply to dominant lethals produced in Drosophila virilis and sex-linked recessive lethals produced in Drosophila melanogaster. The stages of spermatogenesis from spermatogonia to mature sperm differ among themselves in their response to the same amount of x radiation and to the oxygen effect and its reduction or enhancement by the other gases. (auth)

55

STIMULATION BY X-RADIATION OF ENZYME INDUCTION AND GROWTH IN ESCHERICHIA COLI. H. Laser and Margaret J. Thornley (Univ. of Cambridge, Eng.). Proc. Roy. Soc. (London) B150, 539-53 (1959) Sept. 1.

Escherichia coli B has been grown in a liquid medium containing, besides inorganic salts, glucose and ammonium chloride as sole sources of carbon and nitrogen. The micro-organisms do not grow if maltose is substituted for glucose. Similarly, washed suspensions of E. coli which oxidize glucose vigorously have an insignificant O_2-uptake with maltose. However, maltose is utilized for growth if NH_4Cl is replaced by glutamic acid. Apparently the bacteria cannot form the enzyme needed to utilize maltose from their existing protein equipment but can if given a suitable organic nitrogen source. X radiation of 4 to 8 kr (190 kvp, 10 ma, dose rate 8 kr/min) changes these conditions fundamentally. Washed suspensions of irradiated E. coli oxidize glucose as fast as controls, but unlike the controls, develop an increasing respiration in presence of maltose, the maximal rate (after 4 to 8 kr) being attained within 3 hr and approaching that for glucose. This response to maltose is suppressed by chloramphenicol. Micro-organisms viable after irradiation can grow on maltose in the liquid medium with NH_4Cl, although slowly. The viable irradiated micro-organisms multiply with maltose and glutamate much faster than unirradiated controls for most of the logarithmic growth phase. This has been confirmed by turbidity measurements and plate counts. The response to maltose is lost on incubation of the bacteria with glucose and NH_4Cl. Both controls and irradiated E. coli contain maltose. This has been demonstrated with ultrasonically disintegrated bacteria where the addition of maltose and glucose oxidase (notatin) caused an O_2-uptake at equal rates in both samples. These results and further evidence justify the conclusion that the observed irradiation effects are due to the induction of permease for maltose in irradiated micro-organisms. (auth)

56

THE ACCURATE ESTIMATION OF CHROMATID BREAKAGE, AND ITS RELEVANCE TO A NEW INTER-

PRETATION OF CHROMATID ABERRATIONS INDUCED BY IONIZED RADIATIONS. S. H. Revell (Inst. of Cancer Research, Royal Cancer Hospital, London). Proc. Roy. Soc. (London) B150, 563-89(1959) Sept. 1.

If cells are subjected to ionizing radiations as they approach mitosis, chromosome changes are initiated which appear at metaphase as visible discontinuities of chromatid structure and as chromatid exchanges between different chromosomes. The discontinuities have previously been interpreted as surviving examples of a much larger number of chromatid breaks produced at the time of irradiation, and the exchanges as the result of new unions between such breaks that occurred close together. Root meristem cells of the broad bean (Vicia faba), which had received 50 or 65 r of x rays, have been used to test a new interpretation of these changes, according to which each chromatid discontinuity arises from a chromatid exchange between two points close together on one chromosome. On this interpretation, the frequency of chromatid discontinuities at metaphase should be much lower than those of most other aberrations: it is shown that the high value usually obtained is due to the inclusion of a large proportion of short unstained but structurally continuous gaps, and that the frequency of true breaks is as low as the new hypothesis requires. It is accepted that radiation dosage and dose-intensity experiments indicate that chromosomes suffer primary events at the points where and when they are crossed by the tracks of single ionizing particles; and also that, although themselves unstable, pairs of such primary events that are close enough together in space and time can together enter a second stable state of exchange initiation. If the new hypothesis is also accepted it is argued to be unlikely that this primary event can be chromatid breakage, as is usually supposed, and unlikely also that exchange initiation can be chromatid reunion. It follows that the chromatid exchange itself is structurally established at some later stage, as the two chromosome points continue their joint development in the affected condition. (auth)

57

BIOLOGICAL EFFECTS OF THE RAYS PRODUCED BY A CYCLOTRON. I. EXPERIMENTS ON THE SPLEENS OF MICE. Masanori Nakaidzumi and Kôiti Murati. Sci. Papers Inst. Phys. Chem. Research (Tokyo) 34, 357-61(1958) Mar.

The pathological effects of cyclotron rays were demonstrated on the spleen of mice. The rays were produced by bombarding a beryllium target with 2.8 Mev deuterons from a cyclotron. The rays produced were predominantly neutrons. Mice were exposed for various periods of time and sacrificed at periods of from one to twenty-five hours after exposure. Changes observed upon histologic examination are described. (C.H.)

58

INTEGRAL DOSES FOR 200 kev X AND MEGAVOLT BEAMS. Rolf Wideroe (Universität, Zurich). Strahlentherapie 110, 1-9(1959) Sept. (In German)

The integral doses produced in the body for the same tumor doses have been collected for 200 Kev x rays, cobalt-60 gamma-rays, 31 Mev x rays, and electron beams of optimal energy and compared with each other. The data have been taken in part from publications, in part from own measurements. Electron beams of optimal energy give satisfactory deep doses and are much more favorable for all practically existing tumor depths than other kinds of rays. (auth)

59

THE EFFECT OF PYROGENIC STIMULANTS ON THE LEUKOCYTE VALUES OF IRRADIATED PATIENTS. Robert Bauer, Detlev Schoen, and W. Fischer (Universität, Tübingen, Ger.). Strahlentherapie 110, 10-15 (1959) Sept. (In German)

Irradiation leukopenia, that is to say leukopenia following the therapeutic use of ionizing irradiation, is due to an indirect damage of the white blood cells. This is in contrast to the direct damage of the white blood cells due to whole-body irradiation. Test for bone marrow function with a stimulating agent for leukocytes on 15 irradiated tumor patients demonstrated that the function of the bone marrow was not impaired despite the presence of leukopenia. Two patients who had splenectomy showed no different reaction following irradiation. (auth)

60

THE BEHAVIOR OF BISMUTH-206 COMPLEXES IN EXPERIMENTAL LEUKEMIA OF THE MOUSE. II. Ferdinando Passalacqua and Ruprecht Koch (Universität, Freiburg i. B. and Heiligenberg-Instituts, Ger.). Strahlentherapie 110, 51-6(1959) Sept. (In German)

In normal and leukemic C-57 black mice the distribution of Bi^{206} as carrier-free nitrate, as citrate-carbon-suspension, and as its camphora-carbonate-lecithine compound was studied. It was compared with the distribution of P^{32} as $Na_2HP^{32}O_4$. (auth)

61

THE RADIATION-INDUCED MUTATION RATE FOR RECESSIVE SEX-BOUND LETHAL FACTORS IN SPERMATOGONIA AND MATURE SPERM OF DROSOPHILA MELANOGASTER AFTER IRRADIATION IN AIR AND NITROGEN. Adolf H. Ott (Universität, Zurich). Strahlentherapie 110, 57-65(1959) Sept. (In German)

The mutation rate (MR) for recessive sex bound lethal and semilethal factors was determined on sperms of Drosophila melanogaster which fertilized 0 to 24 ± ½ hours and spermatogonia which fertilized 21 to 24 days after irradiation by 2000 r in air. On irradiated mature sperms a MR of 3.42% for lethal and of 0.73% for semilethal factors was found. After irradiation of spermatogonia 0.41% lethal and 0% semilethal factors were observed. Therefore about 9 times more recessive lethal factors were observed on the mature sperms than on the spermatogonia. The same types of germ cells were irradiated in pure nitrogen with the same dose and the MR determined for lethal and semilethal factors. On sperms a MR of 2.86% lethal and 0.30% semilethal factors was found. On spermatogonia the MR was 0.40% lethal and 0.20% semilethal factors. The presence of pure nitrogen during the irradiation therefore has no protective effect on the formation of recessive sex bound lethal factors in spermatogonia. There seems to be a slight protective effect in mature sperms which is, however, not well enough founded by statistical data. (auth)

62

THE EFFECTS OF 200 r WHOLE-BODY X RADIATION ON THE PLACENTA OF THE WHITE MOUSE. CONTRIBUTION TO THE QUESTION OF RADIATION DAMAGE OF THE EMBRYO IN THE UTERUS. Joachim Knopp and Johannes Trautmann (Freien Universität, Berlin and Städt. Krankenhaus Moabit, Berlin). Strahlentherapie 110, 70-82(1959) Sept. (In German)

Whole-body irradiation with 200 r at the 7th day after fertilization of white mice caused a more frequent failure of the implantation as compared with animals which were not irradiated. There were no differences concerning spontaneous resorption or the number of implanted embryos. The placenta of the irradiated animals was smaller than the placenta of animals which were not irradiated. The number of cells in the B-placentas was less but the size of the cells was usually greater than in the organs of the N-type. The surface of the labyrinth of the placenta, available for hemo-trophic nutrition, was reduced to one half after irradiation. The bed of the trophoblast was frequently early consumed. Since the mice embryos which were irradiated at the 7th day of pregnancy by 200 r whole-body irradiation had only one sixth of the normal weight at the 20th day of their life, the radiation effect on the trophoblast has to be considered as relatively little. It is however likely that the retarded development of the placenta plays an important part in the consideration of fetal radiation damages. (auth)

63

DOSE MEASUREMENTS ON Y^{90} BEADS FOR ELIMINATION OF THE HYPOPHYSIS. Gustav Notter and Gunnar Walinder (Radiumhemmet, Stockholm). Strahlentherapie 110, 95–100(1959) Sept. (In German)

Densimetric studies on small spheric Y^{90} beads for transnasal elimination of the hypophysis, and standardizations of film exposures by means of a liquid yttrium standard, were described. The amount of Bremsstrahlung was determined. The dose causing necrosis of the tissue of the hypophysis is between 90,000 and 110,000 rad according to these experiments. If the activity of each bead is 0.08 mc and the depth of necrosis is 3 mm, which is sufficient for total elimination of the hypophysis by means of this technique, a dose of 400,000 rad is delivered at 1 mm distance from the periphery of the beads. (auth)

64

PREOPERATIVE IRRADIATION OF BRONCHIAL CARCINOMAS. Wilhelm Widow (Akademie der Wissenschaften, Berlin). Strahlentherapie 110, 133–44(1959) Sept. (In German)

Based on histological studies of bronchial carcinomas treated preoperatively by cobalt–60 irradiation, the radiation induced changes of the pulmonary tissue were pointed out. Their possible improvement by better selection of the ports is questionable. Sufficient statistical data about the value of preoperative irradiation are not available yet. It can be said that a more strict indication for the preoperative irradiation seems necessary. Its general use makes it possible that the radiation induced damages of the patient make the results worse instead of improving them. (auth)

65

EFFECT OF RADIATION ON HUMAN HEREDITY. Report of a Study Group Convened by WHO together with Papers Presented by Various Members of the Group. Geneva, World Health Organization, 1957. 168p. $4.00.

The Study Group on the Effect of Radiation on Human Heredity met from August 7 to 11, 1956, in Copenhagen. In addition to the formal report of the Group, papers were presented by twelve members. Separate abstracts have been prepared on these papers. The Group report covers the following topics: the present sources of ionizing radiations of interest for the treatment of prob-

lems related to the genetic effects in man; the importance of recording radiation exposure in individuals and populations; areas in which research is urgent; and the need for additional institutions and departments devoted to general and human genetics. (C.H.)

66

DAMAGE FROM POINT MUTATIONS IN RELATION TO RADIATION DOSE AND BIOLOGICAL CONDITIONS. H. J. Muller (Indiana Univ., Bloomington). p.25–47 of "Effect of Radiation on Human Heredity."

The accumulation of point mutations following repeated irradiations is discussed. It is pointed out that the prime questions regarding the damage done to posterity by a given amount of radiation concerns the total amount of damage and the way in which it will be distributed. Variations in the frequency of lethal or visible mutations as a function of dose and type of cell are discussed. Factors affecting estimations of the absolute frequency of mutations for any given dose and the total frequency of mutations of all kinds are reviewed. Extensive data are included from studies on Drosophila. Species differences and the problem of extrapolation are considered. A procedure based on existing data on spontaneous mutation rate in man is proposed as an important independent possibility for gauging the total mutational damage which would be produced by radiation in a human population. (C.H.)

67

TYPES OF MUTATION PRODUCED AT KNOWN GENE LOCI AND POSSIBILITY OF HITHERTO UNRECOGNIZED MUTATIONS BEING INDUCED. IRRADIATION OF ANIMAL POPULATIONS: RESULTS AND WORK NEEDED. T. C. Carter (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.49–56 of "Effect of Radiation on Human Heredity."

It is pointed out that it is commonly accepted as a working hypothesis that ionizing radiations do not induce new types of mutation, but only raise the mutation rates of existing alleles. This assumption is based partly on theoretical and partly experimental factors. However, this hypothesis forms the basis of all present-day estimates of the genetic hazard of ionizing radiation to man. This hypothesis is discussed in terms of the classification of human genes. It is postulated that geneticists should not blind themselves to the fact that unconditionally deleterious oligogenes may constitute only a small fraction of the human genome. It is pointed out that we know something about mutation in man and experimental animals, but we know very little about the effect on a population in which mutation is induced. Data are reviewed from a number of genetic studies on populations of Drosophila. It is pointed out that it is essential to extend studies of radiation effect to other species, including mammals, and that we have no mandate from experimental fact to extend to the whole human genome the theoretical treatment of the genetic hazard of radiations that we now apply to grossly deleterious gene mutations. The first task of human genetics must be to identify as completely as possible that part of the social load which is due to genes of this class. (C.H.)

68

SOME OF THE PROBLEMS ACCOMPANYING AN INCREASE OF MUTATION RATES IN MENDELIAN POPULATIONS. Bruce Wallace (Biological Lab., Cold Spring Harbor, L. I., N. Y.). p.57–62 of "Effect of Radiation on Human Heredity."

Problems arising from the exposure of man to irradi-

ation are reviewed. Topics discussed include the need for the development of a theory of population genetics adequate for the formation of predictions; the design of experiments capable of testing the theory and of supplying empirical values for various parameters; and the extrapolation of theory and experimental results to human populations. It is pointed out that information required for the manipulation of equations under experimental models of the genetic structure of a population, where the model stresses homozygosity, includes estimates of number of loci; total mutation rates; distributions of mutations in terms of their effects on various components of fitness, in particular viability and fertility; the distribution of deleterious mutations among individuals of a population; and dominance-recessive relationships. Data which may shed light on the selective potentialities of human populations are discussed. (C.H.)

69

EXPOSURE OF MAN TO IONIZING RADIATIONS, WITH SPECIAL REFERENCE TO POSSIBLE GENETIC HAZARDS. R. M. Sievert (Karolinska Hospital, Stockholm). p.63-85 of "Effect of Radiation on Human Heredity."

Possible genetic hazards to man resulting from exposure to ionizing radiations are reviewed. It is pointed out that mutations of the germ cells may involve risks for the offspring as early as the next generation, consequently being of interest to the individual himself, or may constitute a long-term problem in the entire population in the case of irradiation of a large number of inhabitants. The present sources of radiation which are of interest from the genetic standpoint are discussed. The contribution of strontium-90 and cesium-137 from fall-out is considered. Data are presented on levels of radiation in Sweden during 1956 and estimations are included on the exposure of the population from natural and artificial sources for a period of thirty years. (C.H.)

70

DETECTION OF INDUCED MUTATIONS IN OFFSPRING OF IRRADIATED PARENTS. J. Lejeune (Centre National de la Recherche scientifique, Paris). p.87-94 of "Effect of Radiation on Human Heredity."

Since human geneticists cannot employ methods such as those used for Drosophila they must resort to statistical comparisons. Difficulties are discussed which arise in the selection of two populations of children supposedly identical in all respects except the dose of roentgens received by the gonads of their parents. Data are summarized from available studies on the frequency of abnormalities, frequency of miscarriages and still-births, and variations in sex ratio in the offspring of irradiated parents. (C.H.)

71

GONAD DOSES FROM DIAGNOSTIC AND THERAPEUTIC RADIOLOGY. W. M. Court Brown (Western General Hospital, Edinburgh). p.95-9 of "Effect of Radiation on Human Heredity."

Data are summarized from recent estimates of the gonad dose to the population resulting from diagnostic and therapeutic radiology. These range in value from approximately 10% of the background radiation to approximately 56%. The author states that there is no direct evidence of a steady upward trend in the incidence of any of the undesirable traits that might be expected with any increase in the mutation rate due to the steady expansion of medical radiology. However, some evidence is presented that an increase in undesirable

traits may already be taking place. An example cited is the apparent increase in mortality from leukemia. (C.H.)

72

MUTATION IN MAN. L. S. Penrose (University Coll., London). p.101-13 of "Effect of Radiation on Human Heredity."

The study of gene mutation in man involves the ascertainment of spontaneous mutation rates at specific loci. The effects of ionizing radiation on mutagen production are considered. Estimations of mutation rates in man, in relation to any given hereditary trait, depend upon ascertaining the incidence of the trait in the general population, the nature of the genetical contribution of the cause of the trait, and the fitness of the genotypes concerned. These phenomena are not necessarily constant. The most favorable case for estimating mutation rate directly occurs when the gene studied is detectable with certainty or regularity in heterozygotes. However, the ideal kind of regular dominance required for this is rarely found in human genetics. The situation for sex-linked genes is theoretically more favorable, but only occasional families are observed in which the probability is great that a fresh mutation has been produced. For recessive traits the problem is much more difficult since heterozygous carriers are not detectable in ordinary circumstances. Data are summarized on mutation rates which have been calculated for a large number of genes in man. The author states that he is of the opinion that most mutation rates already calculated are too high. The effect of induced mutations, the sensitivity of human loci to radiation, and the load of abnormal genes in man are discussed. The writer points out that improved living conditions are likely to reduce the frequencies of recessive genes whose prevalence is due to heterozygous advantage. Thus genetic damage which may be done by the increase in mutation rate due to industrial and medical uses of radiation may be offset in the future by the improvements in hygiene which are taking place at present all over the world. (C.H.)

73

POSSIBLE AREAS WITH SUFFICIENTLY DIFFERENT BACKGROUND-RADIATION LEVELS TO PERMIT DETECTION OF DIFFERENCES IN MUTATION RATES OF "MARKER" GENES. A. R. Gopal-Ayengar (Indian Cancer Research Centre, Bombay). p.115-24 of "Effect of Radiation on Human Heredity."

Conditions are described in certain parts of the monazite belt of Travancore, India, which are particularly favorable for studies of the differences in mutation rates in human populations due to differences in background radiation. The exposure to the population on the monazite sands is caused by the intake of radioactive thorium through air, water, and food. The population has been more or less stationary for generations, and the alleviating action of modern medical services has not been present. A control population of comparable dimensions, with similar conditions and normal background radiation exists nearby. A careful study of the population structure in this area should furnish information concerning gene frequencies and their distribution in time and space, as well as data on mutation rates for particular traits such as autosomal dominants or sex-linked recessives. (C.H.)

74

COMPARISON OF MUTATION RATES AT SINGLE LOCI IN MAN. A. C. Stevenson (Queen's Univ. of

Belfast). p.125-37 of "Effect of Radiation on Human Heredity."

Practical problems are discussed that arise in attempting to compare phenotype frequency, gene frequency, and mutation rates between different human populations. The types of traits suitable for use as markers, autosomal dominant genes, and sex-linked genes are discussed. Statistical problems involved are summarized. (C.H.)

75

SOME PROBLEMS IN THE ESTIMATION OF SPONTANEOUS MUTATION RATES IN ANIMALS AND MAN. James V. Neel (Univ. of Michigan, Ann Arbor). p.139-50 of "Effect of Radiation on Human Heredity."

Problems encountered in estimations of spontaneous mutation rates are considered, with emphasis on the rate of mutation of mammalian genes, and dangers involved in extrapolation from animal studies to man. Estimates of the rate of mutation of human genes are reviewed. It is stated that in the current state of our knowledge, students of the problem can select and justify estimates differing from one another by a factor of 100. It is concluded that extensive animal experimentation is needed in attempts to evaluate the genetic risks of increased radiation for the human species. (C.H.)

76

EFFECT OF INBREEDING LEVELS OF POPULATIONS ON INCIDENCE OF HEREDITARY TRAITS DUE TO INDUCED RECESSIVE MUTATIONS. N. Freire-Maia (Univ. of Paraná, Brazil). p. 151-6 of "Effect of Radiation on Human Heredity."

Results are reported from a survey on inbreeding levels under which the present-day Brazilian population live, as well as the magnitude of the same parameter during the last 150 years. Some localities were found where as many as one out of five marriages are contracted between first cousins, and one out of three marriages is consanguineous up to and including second cousins. The potential usefulness of this situation in the study of the general effect of consanguineous marriages on the genetic make-up of populations is considered. Results are reported from preliminary studies of the mean number of deleterious recessive genes per individual. (C.H.)

77

DETECTION OF GENETIC TRENDS IN PUBLIC HEALTH. Howard B. Newcombe (Atomic Energy of Canada Ltd., Chalk River, Ont.). 157-68 of "Effect of Radiation on Human Heredity."

A procedure is described for the collection of specific data on variation in human populations. The procedure employs mechanical methods for matching and sorting punch cards which form a family register index. The register would contain information on the family relationships of the individuals who make up the population. Data would be easily available on marriages, births arising out of those marriages, stillbirths, the death of offspring, marriages between first cousins, disease conditions, environment, socioeconomic class, age of mother and father at time of birth, family size and spacing, racial origin, gestation period, legitimacy or illegitimacy, home or institution birth, and supplementary information. Eventual applications in long-range studies of the genetic consequences of radiation in human populations are discussed. (C.H.)

78

WISSENSCHAFTLICHE REFERATE UND BERICHTE DER 2. TAGUNG DER ARBEITSGEMEINSCHAFT DER STRAHLENSCHUTZARZTE DES DEUTSCHEN ROTEN KREUZES BONN, 28.-30. NOVEMBER 1956. (Scientific Reviews and Reports of the Second Meeting of the Study of the German Red Cross from November 28 to 30, 1956, in Bonn). Siegfried Balke. No. 1 of "Schriftenreihe des Bundesministers fur Atomkernenergie und Wasserwirtschaft. Strahlenschutz." Brunswick, Gersbach and Sohn Verlag GmbH, 1957. 184p. DM 4.

The papers and reviews given at the second working conference of German Red Cross radiologists are presented. The topics discussed include radiation effects on gene constitution, radiation damage of human genes, pathological and anatomical study of radiation genetics and radiation damage of fetus, gynecological consequences and embryonic damage in radiation burdens, arrangement of isotopic laboratories, incorporation of radioactive materials, evaluation of radiation protection precautions, ultrasonic resistance of leukocytes in acute radiation syndrome in rats, procedures in catastrophic incidents, first-aid in radiation injury, and contamination of soil, water, and air with radioactive particles. Brief reviews were also presented on the work of various conferences, congresses, and commissions. (J.S.R.)

Radiation Sickness

79   AEC-tr-3729

PATHOLOGIC PHYSIOLOGY OF ACUTE RADIATION SICKNESS. (EXPERIMENTAL MATERIALS ON BIOLOGICAL ACTION OF EXTERNAL IONIZING RADIATIONS). (Patologicheskaya Fiziologiya Ostroĭ Luchevoĭ Bolezni. (Eksperimental'nye Materialy po Biologicheskomi Deistviyu Vneshnikh Ioniziruyushchikh Izluchenii)). P. D. Gorizontov, ed. Translated by Lydia Venters (Argonne National Lab.) from a publication of the State Publishing House of "Medical Literature," Moscow, 1958. 331p. OTS.

The pathogenesis of radiation sickness caused by ionizing radiations is considered. Topics discussed include general problems of the pathologic physiology of radiation sickness, changes in the nervous system in radiation sickness, humoral factors, metabolism, hematopoiesis, and the reactivity of the organism during radiation sickness. (C.H.)

CHEMISTRY

General and Miscellaneous

80   AERE-AM-46

United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England.

THE SPECTROGRAPHIC ANALYSIS OF INORGANIC NON-METALLIC MATERIALS BY THE IRON FLUX METHOD. J. C. Cotterill. June 1959. 17p. BIS.

The sample, in the form of a powder, is mixed with a flux containing ferric sulfate. Pellets of this mixture are excited in a d-c arc using copper electrodes. Spectra are evaluated by visual comparison of lines due to the sample with those due to the iron, using

tables of line-pair equalities prepared from the spectra of standard mixtures. (auth)

81　　　AERE-C/M-198

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
THE POSSIBILITY OF FUSED FLUORIDE FUEL SYSTEMS FOR HOMOGENEOUS REACTORS. PART I. GENERAL INTRODUCTION AND THE SYSTEM $NaF-PbF_2-UF_4$. J. K. Dawson and A. E Truswell. Feb. 1954. Decl. July 21, 1958. 8p. (RCTC/P-6).

A literature survey has revealed a number of possible binary and ternary combinations of metallic fluorides of low neutron cross section which should be investigated for low-melting eutectics and for uranium tetrafluoride solubility so that their value as working fluids in homogeneous reactors may be assessed. There is appreciable miscibility of UF_4 with the $NaF-PbF_2$ eutectic at temperatures in the region of 500°C. Thermal analyses have shown that the ternary eutectic lies at 472°C and 16 mol. % UF_4. (auth)

82　　　ANL-6054

Argonne National Lab., Lemont, Ill.
FLUID-BED CONVERSION OF URANIUM TETRAFLUORIDE TO URANIUM HEXAFLUORIDE. C. J. Vogel and W. J. Mecham. Oct. 1959. 25p. Contract W-31-109-eng-38. OTS.

Experiments conducted in a $2\frac{1}{2}$-inch diameter reactor have demonstrated that the continuous fluorination of uranium tetrafluoride to hexafluoride with elemental fluorine in a fluidized bed is possible. Practicable fluorine efficiencies and conversion rates were attained with good temperature control in experiments with refined uranium tetrafluoride. Runs made with crude uranium tetrafluoride, derived from the reduction and hydrofluorination of ore concentrates produced by the acid-leach process, indicated that these also can be processed at satisfactory rates and efficiencies. Uranium tetrafluoride derived from carbonate-leached ore concentrate gave a lower production rate and was more difficult to process because of sintering tendencies. (auth)

83　　　CF-55-12-128(Del.)

Oak Ridge National Lab., Tenn.
MEASUREMENT OF THE VISCOSITY OF COMPOSITION 31. S. I. Cohen and T. N. Jones. Dec. 23, 1955. Decl. with deletions Mar. 15, 1957. 3p. OTS.

Viscosity measurements were made on Composition 31 ($NaZrF_5$) and the viscosity was found to vary from ~11.3 centipoises at 550°C to ~2.9 centipoises at 850°C. (W.L.H.)

84　　　CF-59-8-118

Oak Ridge National Lab., Tenn.
EVALUATION OF LINER MATERIAL AND PRODUCT CONSOLIDATION IN THE DRUHM PROCESS. D. R. Edwards. Sept. 3, 1959. 10p. OTS.

Tests were made to evaluate magnesia and graphite as possible liner materials for the Druhm reaction ($UF_6 + 6Na \rightarrow U + 6NaF$) and to evaluate the effect of temperature on product consolidation and separation. In these tests, graphite held up better than magnesia; however, both were attacked by sodium. Appreciable uranium metal consolidation took place at temperatures greater than 1180°C. The results of a literature survey indicated that the most promising liner materials are magnesia, graphite, and graphite coated with a refractory material. (auth)

85　　　DP-391

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.
NUCLEAR MAGNETIC RESONANCE SPECTRA OF NITROGEN-14 IN RUTHENIUM NITROSYL COMPLEXES. Bruce B. Murray. June 1959. 8p. Contract AT(07-2)-1. OTS.

Measurements were made of the nuclear magnetic resonance (NMR) spectra of N^{14} in $Na_2RuNO(NO_2)_4OH$, $RuNO(Cl)_3(H_2O)_2 \cdot 3H_2O$, and $RuNO(NO_3)_3(H_2O)_2 \cdot xH_2O$. The NMR spectra observed for $Na_2RuNO(NO_2)_4OH$ were interpreted to show that the nitrogen atom in each of two of the NO_2 groups was bonded differently from the nitrogen atoms in the other groups. The nitrato groups in $RuNO(NO_3)_3(H_2O)_2 \cdot xH_2O$ were inferred to be equivalent and their nitrogen atoms to be bonded similarly to the nitrogen atoms in the nitrate ions in aqueous solutions of NH_4NO_3. (auth)

86　　　GAT-252

Goodyear Atomic Corp., Portsmouth, Ohio.
OXIDE FLUORINATION TOWER. L. C. Peoples. Aug. 28, 1959. 25p. Contract AT(33-2)-1. OTS.

A 3-inch-diameter flame tower for the conversion of uranosic oxide to uranium hexafluoride with elemental fluorine was tested for possible use in the fluorination step of the present uranium recovery process. The oxide was fed from a hopper to the tower by a screw feeder. The fluorine and the oxide entered at the top and flowed concurrently down through the tower. The unreacted or partially reacted oxide was collected in an ash receiver at the bottom. Fine solid particles were removed from the gas stream by an electrostatic precipitator and a tube-type filter. The uranium hexafluoride was collected in cold traps. Twenty-five experimental runs were conducted with average oxide feed rates from 3.73 to 19.38 lb/hr. The average fluorine flow rates were from 7.5% below to 448% above the stoichiometric amount of fluorine required. The best operating conditions were at a feed rate of 15 lb of oxide per hour with a minimum fluorine excess of 75% (10.6 lb of fluorine per hr). The material collected in the tower ash receiver represented between 6.0 and 10.0 percent of the total amount of uranium fed during the run. The ash, combined with an equal weight of oxide, can be fed back to the tower. The electrostatic precipitator was capable of collecting up to 92% of the solids in the gas stream. A porous-tube filter worked best for the removal of the remaining particles in the gas stream. The experimental runs have shown that uranosic oxide can be satisfactorily converted to uranium hexafluoride in a 3-in.-diameter flame tower of simple design. The present conversion rate of uranosic oxide, approximately 4 lb per manhour with the tube reactor, could be increased to 10 lb per manhour by using the flame tower. (auth)

87　　　KAPL-M-NJH-2

Knolls Atomic Power Lab., Schenectady, N. Y.
PROCESS OF THE STORAGE OF PLUTONIUM HEXAFLUORIDE. Norval J. Hawkins. [195?]. Decl. Oct. 15, 1959. 9p. Contract W-31-109-eng-52. OTS.

Freshly prepared PuF_6 may be stored by dissolving in liquid carbon tetrafluoride (CF_4) in quartz or glass vessels maintained slightly warmer than liquid nitrogen temperature (−195°C) to be certain that the solvent is initially in the liquid state. The solution, of predetermined composition, is maintained at liquid nitrogen temperature for the period under storage. Storage

vessels in a supply of liquid nitrogen can be designed which are quite efficient as far as liquid nitrogen evaporation is concerned. To obtain the PuF_6 again in a pure state, the solvent is removed by distillation. This can easily be accomplished by replacing the liquid nitrogen bath by a dry ice−trichloroethylene bath ($-78°C$) and pumping off the solvent, CF_4, as well as any F_2 and C_2F_6 produced. Very little PuF_6 should be lost by such a procedure. (auth)

88   NP-7936

Iowa State Univ. of Science and Technology, Ames.
ORGANO-METALLIC AND ORGANO-METALLOIDAL HIGH TEMPERATURE LUBRICANTS AND RELATED MATERIALS. Progress Report for July 1, 1959 to September 30, 1959. Henry Gilman, William J. Trepka, Bernard J. Gaj, and Gerald Schwebke. 26p. Contract AF33(616)-6127.

The synthesis of 5-ethyl-5,10-dihydro-10,10-diphenylphenazasiline using N-ethyl-2,2'-dibromodiphenylamine as the starting material is described. Possible approaches to the synthesis of unsymmetrical 5,10-dihydrophenazasiline compounds are reviewed. The reactions of triphenylsilyllithium with alkyl and aralkyl halides are discussed. (For preceding period see NP-7735.) (C.W.H.)

89   NP-7937

Hooker Chemical Corp., Niagara Falls, N. Y.
FLUORINE-CONTAINING CONDENSATION POLYMERS AND RESINS. Quarterly Progress Report No. 4 for June 1, 1959 to September 1, 1959. D. Knutson, J. J. Kolano, and C. J. Verbanic. Sept. 15, 1959. 29p. Contract AF33(616)-5548.

Preparation of intermediates such as maleimide, 2,2-difluoropropane-1,3-diol, diethyl dichloromaleate, and perfluoroglutaronitrile is reported. It was found that varying the peroxide catalyst concentration between 0.5 and 2.0% had a relatively minor effect on the room temperature or elevated temperature ($260°C$) flexural strengths of fluorinated glycol polyester laminates. The same was true for laminates prepared from the corresponding hydrocarbon glycols. The usual polyesters are made with fumaryl chloride and isophthaloyl chloride (ratio 3 to 1). The isophthalate segments are added to reduce the crystallinity and melting points of the polyesters and thus simplify the laminating procedure. It was hoped, that by reducing the number of isophthalate segments, a higher cross-linking density would be obtained, which would be reflected in higher initial flexural strengths. When the number of isophthalate fragments was decreased, it was necessary to use higher laminating temperatures and the resulting laminates had lower initial flexural strengths. Varying the ratio of fluorinated glycol polyester to triallyl cyanurate between 75 : 50 and 50 : 150 had no profound effect on the aging characteristics of the laminates; however, ratios in the neighborhood of 50 : 50 appear optimal. Preliminary results indicate that fluorinated glycol polyester laminates cross-linked with triallyl cyanurate-maleimide mixtures have initial flexural strengths of 60,000 to 70,000. These may be compared with 40,000 to 45,000 for laminates prepared from triallyl cyanurate. The maleimide-triallyl cyanurate laminates also show improved flexural strengths after aging 100 hours at 260°C. Testing of hexafluoropentane diol polyester-triallyl cyanurate laminates after aging at 316°C reveals indications of rapid deterioration. However, the laminates retain appreciable room tem-

perature strength after 25 hours. Synthetic work on noval fluorine-containing intermediates was continued. (auth)

90   NP-7941

Florida. Univ., Gainesville. Engineering and Industrial Experiment Station.
SYNTHESIS OF SEMI-INORGANIC FLUORINE POLYMERS. Quarterly Progress Report No. 4 [for] June 1, 1959 through August 31, 1959. Henry C. Brown. 47p. Contract AF33(616)-5616.

Triethyl amine and dimethyl amine have been shown to be effective catalysts for the copolymerization of perfluoroglutarodinitrile with perfluorobutyronitrile. Copolymerization of perfluoroglutarodinitrile with perfluorobutyronitrile in the presence of aluminum chloride or boron trifluoride gave non-uniform products, apparently partially carbonized. Copolymerization of perfluoroglutarodinitrile with perfluoropropionitrile or with trifluoroacetonitrile in the presence of ammonia gives products distinctly different from those obtained from the dinitrile with the C_4 mononitrile. Copolymerization of perfluoroglutarodinitrile with perfluorobutyronitrile in Kel-F Oil in the presence of ammonia gives both a gas-phase reaction product and a liquid phase polymer. Perfluorobutyramidine was reacted with phosgene in a modified Pinner synthesis. Reaction rate studies of the deammonation of perfluorobutyramidine indicate an initial second order reaction which, presumably, forms a dimer of the starting compound. (auth)

91   NP-7943

Pennsalt Chemicals Corp., Wyndmoor, Penna.
THE COMPOSITION AND PROPERTIES OF ZIRKLOR. Technical Report No. 7. F. L. Scott, H. Q. Smith, and I. Mockrin. Sept. 10, 1959. 8p. Contract Nonr-2687(00).

"Zirklor" (ZrCl) was prepared by the electrolysis of $ZrCl_4$ in a fused salt bath. The properties claimed for Zirklor, which was obtained as black flakes: good lubricating power, thermoplasticity, and stability to $1000°C$. The chemical reactivity of Zirklor was studied. (W.L.H.)

92   NRL-5350

Naval Research Lab., Washington, D. C.
SOME STRUCTURAL GUIDES TO THE DEVELOPMENT OF HIGH DIELECTRIC CONSTANT ESTERS FOR CAPACITORS. J. B. Romans and C. R. Singleterry. June 1, 1959. 25p. Project NE 110-000-17.25.

It has been found possible to use molecular structure as an effective guide to the synthesis of practical liquids of high dielectric constant. For this purpose, dipole moments estimated from molecular structure by the generalizations listed are inserted in the Onsager equation relating dipole moment and dielectric constant. In order to obtain liquids of high dielectric constant, the dipole moment content per unit volume must be at a maximum. This is achieved with fluoroesters through the use of the lower telomeric fluoroalkyl groups containing the $-CF_2H$ terminal group and by increasing the number of ester groups to three. High dielectric constants are also significantly favored by the presence of groups, such as aromatic rings or chlorine substituents, which have high electronic polarizability. The application of these principles has led to the synthesis of five fluoroesters having dielectric constants of 8 or above. A route is indicated for the preparation of stable esters having dielectric constants at least as high as 12. (auth)

93   NYO-2156

Temple Univ., Philadelphia. Research Inst.
SECOND ANNUAL PROGRESS REPORT TO THE
UNITED STATES ATOMIC ENERGY COMMISSION.
J. G. Floss. Sept. 28, 1959. 29p. Contract AT(30-1)-
2082. OTS.

It was discovered that the reduction of potassium-
and ammonium perrhenate with potassium metal in
aqueous ethylenediamine yields a complex, water solu-
ble hydride of rhenium and not an uninegative rhenide.
Analytical investigations suggest the formula $KReH_4 \cdot$
$2H_2O$. The corresponding barium compound was also
prepared. Exploratory experiments on the reduction
of Tc^{99}-labeled NH_4ReO_4 showed that pertechnetate is
also reduced to a water soluble compound of a lower
oxidation number of technetium, presumably a techno-
hydride. This technohydride, however, is considerably
less stable and more sensitive to protons than per-
rhenate. (auth)

94   NYO-4885

Western Reserve Univ., Cleveland. Morley Chemical
Lab.
THERMODYNAMIC PROPERTIES OF SULFURYL
FLUORIDE FROM 12°K TO ITS BOILING POINT. THE
ENTROPY FROM MOLECULAR AND SPECTROSCOPIC
DATA. F. J. Bockhoff, R. V. Petrella, and E. L. Pace.
Sept. 28, 1959. 23p. Contract AT(30-1)-824. OTS.

The heat capacity of sulfuryl fluoride was measured
from 12 to 218°K. A lambda transition was observed at
65.7°K. The heat of fusion at the triple point tempera-
ture, 137.34°K, was 1073 cal/mole. The heat of vapori-
zation at the normal boiling point, 217.78°K, was 4594
cal/mole. The vapor pressure data are closely repre-
sented by the equation: $\log_{10}P_{mm} = 7.8323 - 1071.235/$
$T - 0.01391 \log_{10}T$. The liquid density from 182 to 204°K
is closely represented by the equation: $d = 2.576 -$
$0.004044\ T$. The entropy of sulfuryl fluoride gas was
calculated from the calorimetric data and the third law
of thermodynamics to be 62.63 E.U./mole at 217.78°K.
The calculated spectroscopic entropy was 63.24 E.U./
mole. The discrepancy, 0.61 E.U./mole, is attributed
to randomness in the solid at 0°K. (auth)

95   NYO-8616

Mellon Inst., Pittsburgh.
VIBRATIONAL SPECTRA OF INORGANIC COMPOUNDS.
Progress [Report for] January 2, 1959 through Septem-
ber 1959. Foil A. Miller. Sept. 30, 1959. 14p.
Project FR-213A. Contract AT(30-1)-1993. OTS.

Work has been completed on three topics: the infra-
red and Raman spectrum of CrO_2Cl_2, the infrared and
Raman spectrum of $TiBr_4$, infrared spectra of inorganic
ions in the cesium bromide region (700 to 300 cm^{-1}).
The results are summarized briefly. Experimental
work on the vibrational spectrum of $Si(NCO)_4$ is finished
but not yet written up. The small grating infrared in-
strument for use below 300 cm^{-1} is now operating. Good
progress has been made in obtaining the Raman spectra
of colored compounds. Several sources have been tested
for this purpose. (auth)

96   UCRL-8883

California. Univ., Berkeley. Lawrence Radiation Lab.
ISOMERIZATION OF STILBENES (thesis). Peter
Schmid. Sept. 1959. 120p. Contract W-7405-eng-48.
OTS.

The following cis and trans stilbenes were synthe-
sized: stilbene, p-chlorostilbene, p-nitrostilbene, all-
trans azoxystilbene, cis-trans-cis azoxystilbene,
p-aminostilbene, p-N-acetyl-aminostilbene. Decar-
boxylation of p-hydroxy-and p-acetoxy-1-carboxy stil-
bene were studied and in all cases only the trans
isomer were obtained. The following cis stilbene de-
rivatives were prepared by irradiation of the trans
derivatives: stilbene, p-hydroxystilbene, p-acetoxystil-
bene, p-aminostilbene, cis-trans-cis and all-cis azoxy-
stilbene. The latter two compounds are extremely un-
stable and isomerize during purification. The reaction
rates were obtained from experiments planned prima-
rily to obtain optimum conditions for the preparation of
new stilbene derivatives. Rates of trans-cis isomeri-
zation at 50°C were obtained for: stilbene $- k\ 1.8 \cdot 10^{-4}$
sec^{-1} in benzene solution, p-acetoxystilbene $- 1.2 \times 10^{-4}$
sec^{-1} in benzene, p-hydroxystilbene $- 2.0 \times 10^{-4}\ sec^{-1}$ in
ethanol, p-aminostilbene $- 9.8 \times 10^{-4}\ sec^{-1}$ in 50%
ethanol $- 2\ \underline{N}$ HCl. Rate constants for thermal, that is,
cis-trans isomerization were evaluated for trans-cis-
trans azoxystilbene. Its rate constant at 0°C in 10%
benzene n-hexane is $6.9 \cdot 10^{-5}\ sec^{-1}$. Therefore no pure
trans-cis-trans azoxystilbene could be isolated. The
thermal isomerization of cis aminostilbene in 2 n hy-
drochloric acid-50% ethanol was studied at 40 and 80°C.
The energy of activation was 15.5 kcal/mole. At 50° the
rate constant of cis-trans isomerization is then k =
$4.2 \cdot 10^{-5}\ sec^{-1}$. From the rate constant for the reverse
reaction an equilibrium constant of K = k trans $-$cis/
k cis $-$trans = 23 is calculated and thus trans-aminostil-
bene as the cation can be isomerized under the influ-
ence of ultra violet light to the extent of 96%, although
the actual yield must undoubtedly be smaller due to
secondary reactions. The pK of cis and trans p-amino-
stilbene was measured in 30% methanol citrate buffer.
It is found that the two isomers have, within experimen-
tal error, identical pK values of 4.10 at 25°C. Ham-
mett's substituent constant is therefore of the order of
$\epsilon = 0.06$. Under certain conditions, it seems possible
to diazotize cis aminostilbene to yield cis stilbene-
diazonium salts. The spectra of both the cis and trans
diazonium ion were measured as well as their coupling
product with H-acid. There is good evidence that the
reduction of cis stilbene-diazonium ion with hypophos-
phorous acid yields mainly cis stilbene. Systematic
collation of the spectra of the monosubstituted stilbenes
prepared, for both the cis and trans isomer, were made
and the results compared with analogs in the benzene
series. In addition, infrared spectra were measured.
The cis derivatives show a sharp characteristic ab-
sorption band at 915-920 wave numbers. For the trans-
derivatives a characteristic absorption band is found at
957-968 wave numbers. (auth)

97   WADC-TR-55-271(Pt. II)

Quantum Inc., Cheshire, Conn.
RESEARCH ON ELEVATED TEMPERATURE RESIST-
ANT INORGANIC POLYMER STRUCTURAL ADHE-
SIVES. Period covered: August 15, 1955 to August 15,
1956. Harold H. Levine. Oct. 9, 1956. 29p. Project
title: RUBBER, PLASTIC AND COMPOSITE MATERI-
ALS. Task title: STRUCTURAL ADHESIVES. Con-
tract AF33(616)-2555. (AD-110588).

The progress achieved toward the development of an
elevated temperature resistant inorganic polymer
structural adhesive is described. Such an adhesive
stable at 800°F, with a room temperature shear strength
of 285 lb/sq in. was obtained from the ammeline-
phosphorus pentoxide reaction product. The use of tita-
nium dioxide as a primer and dimethylformamide as an
extractive solvent allowed for development of this shear

strength from an original value of 65 lb/sq in. Evidence was obtained to indicate that the adhesion was a result of chemical interaction between the adhesive and the stainless steel surface. The success of the research to date indicates the necessity of further work to increase the adhesive and flexural strength by chemical methods. This should be done without sacrificing the present heat resistance and preferably with increasing the present thermostability. (auth)

98   WADC-TR-59-136
General Electric Co. General Engineering Lab.,
   Schenectady, N. Y.
EVALUATION OF EXPERIMENTAL POLYMERS. [Period Covered]: April 1958 to April 1959. Charles D. Doyle. May 1959. 146p. Project title: NON-METALLIC AND COMPOSITE MATERIALS. Task title: NEW CHEMICALS AND METHODS. Contract AF33(616)-5576. (AD-216453).

   Thermal stability is discussed in terms of limiting temperatures on the basis of thermodynamic, rigorous kinetic, non-rigorous kinetic, functional-environmental, and empirical considerations. The desirability of rapid empirical methods in general prospecting is discussed, and the term "procedural decomposition temperature" (pdt) is used to emphasize the powerful effect of procedural details on the measured values in empirical tests. Differential thermal analysis (DTA) and thermogravimetric analysis (TGA) are discussed in detail as rapid empirical methods for measuring pdt's. Several experimental materials are tentatively compared on the basis of TGA in inert atmosphere. (auth)

99   WADC-TR-59-207
Michigan. Univ., Ann Arbor.
THE CHEMISTRY OF BORON HYDRIDES AND RELATED HYDRIDES. E. R. Alton, J. C. Carter, C. Cluff, A. E. Emery, C. W. Heitsch, R. W. Parry, R. C. Taylor, C. E. Nordman, G. Kodama, S. G. Shore, C. R. Peters, C. Reimann, J. R. Weaver, and M. Yamauchi. May 1959. 190p. Project No. 3048. Contract AF33(616)-3343. OTS.

   Arguments to support the structure $[H_2B(NH_3)_2]BH_4$ for the diammoniate of diborane were presented in WADC Technical Report 56-318. Additional information relative to the diammoniate of diborane and related structures is presented. A microcrystalline form of $B_2H_6 \cdot 2NH_3$ was obtained and the powder pattern is tabulated for ready compound identification. Relatively strong evidence against the structure $[HB(NH_3)_3](BH_4)_2$ was accumulated. Diammoniate of diborane II which was formerly assigned this structure was shown to consist chiefly of the regular diammoniate with the structure $[H_2B(NH_3)_2]BH_4$. Improved methods for the synthesis of pure salts of the form $[H_2B(NH_3)_2]X$ were developed. A complete single-crystal x-ray crystallographic study which established the structure of $[H_2B(NH_3)_2]Cl$ was completed and the data confirm the structure assignments in detail. The structures of the bromide and iodide salts were also deduced. A nuclear magnetic resonance study of $[HB(NH_3)_2]I$ can best be interpreted in terms of the accepted structure of the cation $[H_2B(NH_3)_2]^+$. The diammoniate of diborane, $[H_2B(NH_3)_2]BH_4$, was prepared by metathesis, a fact which offers complete chemical support for the structure. The mono-, di-, and trimethylamines were prepared as stable compounds, and vapor-pressure measurements, dipole-moment measurements, and Raman spectra were obtained. The data represent part of a

systematic examination of the amine-boranes. Phosphorus trifluoride-borane was examined by means of Raman spectroscopy. Preliminary studies of the reaction between F_3PBH_3 and NH_3 indicate the existence of the new compound, $(NH_2)_3PBH_3$. The Raman spectrum of carbon monoxide—borane is considered. A strong similarity was found between the chemistry of diborane and that of tetraborane. The compounds $B_4H_{10} \cdot 2NH_3$ and $H_3NB_3H_7$ were prepared. On the basis of chemical evidence the structure of $B_4H_{10} \cdot 2NH_3$ is written as $[H_2B(NH_3)_2][B_3H_8]$. A complete single-crystal x-ray study established the detailed structure of $H_3NB_3H_7$. Attempts to prepare $F_3PB_3H_7$ were unsuccessful. The compound Cl_3AlPF_3 was prepared and characterized. The compound $H_3Al[N(CH_3)_2]$ described by Wiberg was confirmed independently and structural studies on the molecule were initiated. A detailed Raman spectral study of B_2H_6 was completed and a detailed spectroscopic study of several borohydrides is described along with force constant calculations. The dipole moment of tetraborane was measured as 0.6D. The bridge hydrogens of decaborane display acidic character on the basis of deuteron exchange studies. (auth)

100   WAPD-CP-460 (Del.)
[Westinghouse Electric Corp. Atomic Power Div.,
   Pittsburgh].
REPORT ON PHASE VI TESTS. [SPECIFICATIONS] T-474945; HYDRAZINE PROOF TEST. [SPECIFICATION] T-474946; FLUX RECOMBINATION PROOF TEST. Yale N. Solomon and Paul Cohen. May 12, 1954. Decl. with deletions Apr. 29, 1957. 16p. OTS.

   Results are presented from tests to determine the effectiveness of oxygen removal from primary water cooling systems by reaction of oxygen with hydrazine and recombination of oxygen with hydrogen under residual gamma flux. Under conditions of the test, hydrazine removal rates were much faster than flux recombination. (W.D.M.)

101   AEC-tr-3841
THE SUBNITRIDE OF CARBON C_4N_2, CYANACETYLENE C_3NH. Charles Moureu and Jacques Ch. Bongrand. Translated for Oak Ridge National Lab. from Ann. chim. (Paris) (9) 14, 1-58(1920). 64p. JCL.

   The history of the discovery of the subnitride of carbon is presented. The preparations of various organic compounds containing carbon subnitride (C_4N_2) structure are reported. The chemical activity of C_4N_2 is discussed. The preparation of cyanacetylene C_3NH is presented. The preparation of various organic compounds containing the C_3NH structure is also reported. (W.L.H.)

102   AEC-tr-3851
FLUORESCENCE OF CERIUM IN SODIUM FLUORIDE MELTS. Nataliya Belegishanin. Translated for Argonne National Lab. from Glasnik Khem. Drushtva, Beograd 21, 271-6(1956). 5p. JCL.

   This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 9742.

103   AEC-tr-3854
SOME PHYSICOCHEMICAL CONSIDERATIONS CONCERNING THE ELIMINATION OF RADIOACTIVE METALS BY MEANS OF COMPLEX PRODUCERS. Hans Jörg Heller and Alexander Catsch. Translated by Lydia Venters (Argonne National Lab.) from Strahlentherapie 109, 464-82(1959). 31p. JCL.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 17748.

104　　　CEA-tr-A-604

UNE NOUVELLE VARIÉTÉ DE BIOXYDE DE MANGANÈSE. (A New Variety of Manganese Bioxide). O. Glemser. Translated into French from Ber. deut. Chem. Ges. 72B, 1879(1939). 7p.

The Debye-Scherrer technique was used to study MnO_2, and a deviation from the diagram for pyrolusite was found. The MnO_2 samples were prepared by three different methods: $KMnO_4 - (NH_4)_2S_2O_3$, $KMnO_4 - Mn(SO_4)_2$, and decomposition of permanganic acid. The results indicate an allotropic modification which was designated $\gamma - MnO_2$. (T.R.H.)

105　　　CEA-tr-A-607

LITHIUM. - 1ÈRE PARTIE. - PREPARATION A PARTIR DE COMPOSES MINERAUX. 2EME PARTIE. - COMBINAISONS DU LITHIUM ET DE L'AZOTE. (Lithium. I. Production From Mineral Compounds. II. Combinations of Lithium and Nitrogen). [L.] Gmelin. Translated Into French from p.14-18; 85-6 of Gmelins Handbuch der Anorganischen Chemie. System Nr. 20. Lithium. Verlag Chemie, Berlin, 1927. 21p.

The preparation and production of Li in lab and in industry from mineral compounds are reviewed. The preparation and properties of nitrides and azides of Li are also reviewed. (T.R.H.)

106　　　CEA-tr-X-59

DIFFUSION, PERMÉABILITÉ ET ABSORPTION DU GAZ DANS ET À TRAVERS DES POLYMÈRES. (Diffusion, Permeability, and Adsorption of Gas Into and Passing Through Polymers). Y. Yano. Translated into French by E. Hara From Kôgyô Kagoku Zasshi 59, 773-9(1956). 30p.

A study was made of modes of diffusion and relation of coefficient of diffusion to the structure of polymer molecules. Also studied were the relations between permeability and adsorption and structure. (T.R.H.)

107　　　CEA-tr-X-143

LA CHIMIE DES LANTHANIDES. (Chemistry of the Lanthanides). S. Misumi. Translated into French by S. S. Minn from Kagaku to Kôgyô (Tokyo) 10, 118-28 (1957). 17p.

A review is presented on the chemical properties of the lanthanide elements including Y. Tabulations are included which give data on mineral compositions, complex stability, absorption coefficients, density, atomic radii, oxidation numbers, solubility products, ion colors, electrolytic potentials, and magnetic susceptibility. (100 references). (T.R.H.)

108

ON THE COMPLEX CHEMISTRY OF THE TERVALENT RARE-EARTH IONS. III. THE GLYCOLATE SYSTEMS. Artur Sonesson (Univ. of Lund, Sweden). Acta Chem. Scand. 13, 998-1010(1959).

The complexity constants of the glycolate systems of ten rare earths were determined by potentiometric measurements. The glycolate systems show a considerably higher complexity than the corresponding acetate systems. This is probably due to the formation of chelates in the glycolate systems. The value of the first complexity constant, $\beta_1 = [MA] \cdot [M]^{-1} \cdot [A]^{-1}$, increases from La to Sm. For the Gd system a somewhat lower value of β_1 is found than for the Sm system. From Gd to Yb, however, β_1 increases again, contrary to the varia-

tion of β_1 for the corresponding acetate systems. The potentiometric measurements show that the formation of anionic glycolate complexes must be assumed. The neodymium glycolate system was also investigated extinctiometrically. The complexity constants obtained in this way are in good agreement with those obtained potentiometrically. (auth)

109

A NEUTRON-DIFFRACTION STUDY OF POTASSIUM COBALTICYANIDE. N. A. Curry and W. A. Runciman (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Acta Cryst. 12, 674-8(1959) Sept.

The methods of neutron diffraction, which permit a distinction to be made between carbon and nitrogen atoms, were used to extend x-ray studies of $K_3Co(CN)_6$. It appears that the carbon atoms are in positions adjacent to the cobalt ions. The methods of Fourier synthesis and least squares were used to obtain improved atomic co-ordinates and values for the Debye-Waller temperature factors. The length of the C—N bonds is reported to be 1.15 A. (auth)

110

THE CRYSTAL STRUCTURE ANALYSIS OF ZIRCONIUM SULPHATE TETRAHYDRATE. Joseph Singer and Don T. Cromer (Los Alamos Scientific Lab., N. Mex.). Acta Cryst. 12, 719-23(1959) Oct.

Zirconium sulfate tetrahydrate is orthorhombic, space group Fddd, with a = 25.92, b = 11.62, c = 5.582 A, and has eight formula units per unit cell. The structure has been determined by x-ray Fourier methods, and refined by least-squares, using data obtained from spherical crystals with a Geiger counter. The structure consists of layers of composition $Zr(SO_4)_2 \cdot 4 H_2O$ normal to the a axis. These layers are probably held together by hydrogen bonds. The hydrate oxygen and one of the sulfate oxygens form an antiprism about the zirconium atom at an average Zr—O distance of 2.180 A. The sulfate group has a small but significant departure from tetrahedral symmetry, the two nonequivalent S—O bonds being 1.443 and 1.486 A, both ±0.014 A. The relationship between this structure and that of uranium(IV) sulfate tetrahydrate is discussed. (auth)

111

THE CRYSTAL STRUCTURE OF $MoCl_5$. Donald E. Sands and Allan Zalkin (Univ. of California, Livermore). Acta Cryst. 12, 723-6(1959) Oct.

$MoCl_5$ has the $NbCl_5$ type structure. The crystal system is monoclinic with a = 17.31, b = 17.81, c = 6.079 A, $\beta = 95.7°$. The space group is C2/m, and there are 12 $MoCl_5$ units in the unit cell. The structure consists of dimers (Mo_2Cl_{10}) with the chlorine atoms forming two octahedra which share a common edge. The molybdenum atoms occupy the centers of the octahedra and are joined by two chlorine bridge bonds. The Mo—Cl bridge bond length is 2.53 A; the Mo—Cl non-bridge bond length is 2.24 A. (auth)

112

DIMORPHISM AND ISOMORPHISM OF ZIRCONIUM(IV) CERIUM(IV), THORIUM(IV), AND URANIUM(IV) ACETYLACETONATES. D. Grdenić and B. Matković (Inst. Rudjer Bošković, Zagreb). Acta Cryst. 12, 817-18(1959) Oct.

The lattice constants for Zr(IV), Ce(IV), U(IV), and Th(IV) acetylacetonates were measured. Th(IV) acetylacetonate is dimorphic. The modifications are both monoclinic but have different unit cells and space groups, i.e., $P2_1/c$ for the α modification and C2/c for

the β modification. Ce(IV) and U(IV) acetylacetonate occur in the same modification with lattice parameters very close to those of the Th compound. For Zr(IV) acetylacetonate only the β modifications has been observed, with the lattice parameters very close to those of the β modification of the Th compound. The space group C2/c necessitates $\bar{1}$ or 2 as the lowest molecular symmetry. Results are tabulated. (J.E.D.)

113

UNIT CELL AND SPACE GROUP OF URANYL ACETATE DIHYDRATE, $UO_2(CH_3COO)_2 \cdot 2H_2O$. V. Amirthalingam, D. V. Chandran, and V. M. Padmanabhan (Atomic Energy Establishment, Trombay, India). Acta Cryst. 12, 821-2(1959) Oct.

Uranyl acetate dihydrate crystallizes as plates and prisms from dilute acetic acid and belongs to the orthorhombic system. The exposed crystals lose their transparency and become amorphous. Its crystal structure has not been reported. The complete structure analysis is in progress. Preliminary results are given. (J.E.D.)

114

POLAROGRAPHIC DETERMINATION OF TITANIUM IN TANTALUM AND NIOBIUM CONCENTRATES AND ORES. Dilip K. Banerjee, Clifford C. Budke, and Franklyn D. Miller (U. S. Industrial Chemicals Co., Cincinnati). Anal. Chem. 31, 1836-9(1959) Nov.

A rapid polarographic method for the determination of titanium in the range of 0.1 to 5% in tantalum and niobium concentrates and ores is described. The supporting electrolyte is $5.4\underline{M}$ sulfuric acid and $0.2\underline{M}$ potassium pyrosulfate. No chemical separation is necessary. Tantalum, niobium, iron, tin, manganese, and tungsten do not interfere. Molybdenum gives a reduction wave in the same region as titanium and will interfere if present in appreciable amounts. Vanadium in appreciable amounts shows no evidence of a wave but does enhance the titanium diffusion current. However, these two elements are not normal constituents of tantalum and niobium concentrates and ores. (auth)

115

POSSIBLE CHEMICAL REACTION OF ORTHOPOSITRONIUM WITH OXYGEN. D. A. L. Paul (Royal Military Coll. of Canada, Kingston, Ont.). Can. J. Phys. 37, 1059-60(1959) Sept.

The effects of oxygen in quenching orthopositronium in liquid argon were studied. A mechanism which would account for the more rapid quenching in liquid than in gaseous argon is the formation of $(e^+e^-)O^2$ following the three-body reaction: $(e^+e^-) + O_2 + X \rightarrow (e^+e^-)O_2 + X$. To account for the enhanced quenching in liquid argon, it is assumed that the ground state of $(e^+e^-)O_2$ is short-lived with respect to annihilation, having $\tau \sim 10^{-10}$ sec; so the reaction is in effect competing directly with other modes of annihilation. (C.J.G.)

116

X RAY STUDY OF THE HYDROGEN—ZIRCONIUM SYSTEM. Lucien Espagno, Pierre Azou, and Paul Bastien. Compt. rend. 249, 1105-7(1959) Sept. 28. (In French)

An x-ray study was made of the H—Zr system. The research showed that the variation of the axial ratio c/a of the ϵ phase of Hägg is distinct from the δ phase. Moreover, the existence of the γ phase pointed out by Gulbransen is confirmed by neutron diffraction. (tr-auth)

117

SINTERING URANIUM OXIDE OF HIGH SPECIFIC SURFACE. Alain Bel, Bernard Francois, Roger Delmas, and Roger Caillat. Compt. rend. 249, 1045-7(1959) Sept. 21. (In French)

The sinterability of a uranium oxide powder prepared from ammonium uranate or uranium peroxide is closely related to the specific surface. When it is greater than $5 \ m^2/g$ there is an optimum sintering temperature in hydrogen. This temperature is lower when the specific surface is higher. (tr-auth)

118

SOME CRYSTALLOCHEMICAL FEATURES OF COMPLEX COMPOUNDS OF RUTHENIUM AND OSMIUM. G. B. Bokii, L. O. Atovmian, and T. S. Khodasheva (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 128, 78-80(1959) Sept. 1.

New data are presented on the structures of complex ruthenium and osmium complexes with No, N, H_2O, and Cl. The complexes $K_2(RuNoCl_5)$ and $K_2(RuCl_5H_2O)$ are isostructural and belong to the distorted-structure type K_2PtCl_6. The structure $K_2(RuNOCl_5)$ is analyzed in detail. The Ru—N—O linear bond with the distance Ru—N = 1.70 and N—O = 1.25A; agreeing with the Me $\equiv {}^+$N—$^-$O bond concept. $K_2\dot{O}s_5 \ NCl_5$ and $KOsNBr_4 \cdot 2H_2O$ are isostructural in spite of their different formulas. In $K_2(OsNCl_5)$ and $K(OsNBr_4H_2O)H_2O$ structures the distance Os—N $\sim$ 1.60 is much shorter than the sum of covalent radii $(1.3\bar{5} + 0.55) = 1.90$. The chlorine atom transposed with respect to the nitrogen atom has a shortened distance along the coordinate N—Os—Cl ($\sim$2.1A) and are close to the sum of normal covalent radii (1.35 + 0.99). A hypothesis is postulated on the existence of the linear group O—Os—O. Similar shorter distances of metal—N and O bond series were observed in both Ru and Os complexes. The hypothesis on linear groups for osmium suggests a new structural expression for a series of complexes. (R.V.J.)

119

A STUDY OF THE PHASE TRANSFORMATIONS OF URANIUM OXIDES IN THE AIR. P. P. Budnikov, S. G. Tresvyatskii, and V. I. Kushakovskii. Doklady Akad. Nauk S.S.S.R. 128, 85-8(1959) Sept. 1.

Heating effects on uranium oxide decomposition are analyzed at room temperature and up to 1600 to 1900°. (R.V.J.)

120

ON THE SELENIDE AND TELLURIDE OF SCANDIUM. A. A. Menkov, L. N. Komissarova, Yu. P. Simanov, and V. I. Spitzyn (Lomonosov Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. 128, 92-4(1959) Sept.

X-ray analyses were made of face-centered cubic scandium selenides with a = 5.405 ± 0.005 kX, and face-centered scandium tellurides with a = 5.805 ± 0.005. The density values for scandium selenides are in good agreement with published data. Based on molecular weights, picnometric densities, and lattice parameters, the number of formula units in the elementary nuclei of Sc_2Se_3 and Sc_2Te_3 compounds is Z = $1\frac{1}{3}$. The crystalline structure of both compounds belongs to the type $\gamma' = Al_2O_3$ with a partial transition in scandium telluride to $\gamma = Al_2O_3$. (R.V.J.)

121

BORON COMPOUNDS. REACTIVITY OF TRIALLYL BORON. A. V. Topchiev, J. M. Paushkin, A. A.

Prokhorova, and M. V. Kurashev. Doklady Akad. Nauk S.S.S.R. 128, 110–12(1959) Sept. 1.

Reactivity of triallylboron was tested with carbonic acid, alcohol, and aldehyde. At room temperature it reacts strongly with all tested compounds. (R.V.J.)

122

THE EFFECT OF THORIUM OXIDE ON THORIUM–HYDROGEN EQUILIBRIUM. David T. Peterson, D. G. Westlake, and J. Rexer (Iowa State Univ., Ames). J. Am. Chem. Soc. 81, 4443–5(1959) Sept. 5.

The increase in hydrogen dissociation pressure with hydrogen content, at constant temperature, in the two phase thorium–thorium hydride region is shown to be related to the dissolution of thorium oxide in thorium hydride. Thorium oxide does not change the equilibrium pressure over the solid solution of hydrogen in thorium nor does it change the hydrogen to free metal ratio in thorium hydride. Thorium hydride with 4.0% ThO_2 in solution was found to be face centered cubic rather than tetragonal. The volume per formula weight was nearly the same for both modifications so that this change probably does not indicate a significant change in the type of bonding. (auth)

123

A STUDY OF THE COMPLEXES OF CURIUM(III) BY ABSORPTION SPECTROMETRY. W. T. Carnall and P. R. Fields (Argonne National Lab., Lemont, Ill.). J. Am. Chem. Soc. 81, 4445–9(1959) Sept. 5.

The absorption spectrum of Cm(III) in $HClO_4$, HCl, HNO_3, and H_2SO_4 in the region 220 to 1400 mμ was studied. A number of new Cm(III) bands were found using larger amounts of curium than were available previously. The relative complexing of Cm(III) in HCl, HNO_3 and H_2SO_4 is indicated and these results are compared with those for Pu(III) and Am(III). Radiation decomposition of the solvent limited the study in concentrated acid solutions. (auth)

124

PREPARATION OF ANHYDROUS RARE EARTH CHLORIDES FOR PHYSICOCHEMICAL STUDIES. J. F. Miller, S. E. Miller, and R. C. Himes (Battelle Memorial Inst., Columbus, Ohio). J. Am. Chem. Soc. 81, 4449–51(1959) Sept. 5.

A method for synthesizing anhydrous rare earth chlorides is presented and discussed. This method, based on conversion of the oxides or mixtures of oxides by reaction with carbon tetrachloride vapor at elevated temperatures, yields chlorides which appear to be superior in quality to those prepared by several other methods which have been described in the literature and were investigated in this research. (auth)

125

SECONDARY HYDROGEN ISOTOPE EFFECTS IN THE HYDROLYSIS OF METHYL p–METHYL–t–BENZOATE. Ernest M. Hodnett, Ray D. Taylor, Jose-Vicente Tormo, and Robert E. Lewis (Oklahoma State Univ., Stillwater). J. Am. Chem. Soc. 81, 4528–30(1959) Sept. 5.

Methyl p–methyl–t–benzoate was hydrolyzed in basic aqueous alcoholic solution and in 99 to 100% sulfuric acid. The tritium-labeled compound reacts slower than the ordinary compound in the basic solution but at the same rate as the ordinary compound in 99 to 100% sulfuric acid. These differences are explained on the basis of greater electron release of the tritium atom through the inductive effect and smaller electron release by the tritium atom through the electrometric effect. (auth)

126

LIQUID SCINTILLATORS. VI. 2–ARYL– AND 2,7–DIARYLFLUORENES. Martin D. Barnett, Guido H. Daub, F. Newton Hayes, and Donald G. Ott (Univ. of New Mexico, Albuquerque and Los Alamos Scientific Lab., N. Mex.). J. Am. Chem. Soc. 81, 4583–6(1959) Sept. 5.

2–Phenylfluorene (II), 2–(4–biphenylyl)–fluorene (IX), 9–methyl–2–(4–biphenylyl)–fluorene (X), 2,7–diphenyl-fluorene (XVI) and 2,2′–bifluorene (VI) were synthesized and screened as potential primary liquid scintillation solutes. Although the scintillation properties of II were inferior to those of p-terphenyl, the pulse-height values for VI, IX, X and XVI were greater than p-quaterphenyl at comparable concentrations. In addition, VI, IX and XVI were evaluated as secondary solutes and found to possess excellent scintillation characteristics. (auth)

127

ABSORPTION SPECTRUM OF UF_4 AND THE ENERGY LEVELS OF URANIUM V. John G. Conway (Univ. of California, Berkeley). J. Chem. Phys. 31, 1002–4(1959) Oct.

The absorption spectrum of U^{4+} was observed from 2000 A to 8μ. All the terms that can arise from two f electrons were found. Terms were assigned to all the absorption peaks. The radial integral, F_2, is 206 cm^{-1}, and the spin-orbit coupling ζ_{5f} is 1870 cm^{-1}. (auth)

128

MONOCHROMATICALLY EXCITED FLUORESCENCE IN RARE EARTH SALTS. F. Varsanyi and G. H. Dieke (Johns Hopkins Univ., Baltimore). J. Chem. Phys. 31, 1066–70(1959) Oct.

Monochromatic excitation, continuously variable in wavelength, makes it possible to analyze in detail the excitation of the fluorescence spectra of rare earth salts. This is a very sensitive method for studying the coupling of the electronic levels with the lattice vibrations. When a crystal contains several kinds of rare earth ions their fluorescence spectra are excited independently of each other. (auth)

129

SPECTRA OF TRIVALENT PRASEODYMIUM AND THULIUM IONS. W. A. Runciman and B. G. Wybourne (Univ. of Canterbury, Christchurch, N. Z.). J. Chem. Phys. 31, 1149–50(1959) Oct.

A least squares method was used to derive new values of the five parameters F_2, F_4, F_6, ξ and α for the energy levels of the Pr^{+3} and Tm^{+3} ions by using the experimental results of several investigators. The experimental data for the Tm^{+3} ion are incomplete with the $^1I_6$, $^1S_0$, and $^3H_4$ levels unobserved. The parameters obtained with and without the inclusion of the orbit-orbit interaction are tabulated. (J.R.D.)

130

ELECTROLYTIC PRODUCTION OF BORON. George T. Miller (Hooker Chemical Corp., Niagara Falls, N. Y.). J. Electrochem. Soc. 106, 815–19(1959) Sept.

Elemental boron was produced by the fused salt electrolysis of potassium fluoborate. A study was made of anode and cathode materials of construction, particularly the effect of various grades of graphite as anode material. The effect of additives to the electrolyte (including potassium, aluminum, calcium, vanadium, nickel, Inconel, water, and sulfate ion) on boron yield and purity was investigated. A method of passivating elemental boron was developed. (auth)

131

VAPOUR-PRESSURES OF NpF_6 AND PuF_6; THERMO-DYNAMIC CALCULATIONS WITH UF_6, NpF_6 AND PuF_6. B. Weinstock, E. E. Weaver, and J. G. Malm (Argonne National Lab., Lemont, Ill.). J. Inorg. & Nuclear Chem. 11, 104-14(1959) Sept.

The vapor pressures of NpF_6 and PuF_6 were measured from 0 to 77°C with a quartz sickle gage. The data were fitted to interpolation formulas from which the triple points, 55.10°C, 758.0 mm Hg for NpF_6 and 51.59°C, 533.0 mm Hg for PuF_6, and boiling points, 55.18°C for NpF_6 and 62.16°C for PuF_6, were calculated. The derived heat and entropy of fusion for NpF_6 and PuF_6 are 4198 and 4456 cal mole^{-1} and 12.79 and 13.72 cal mole^{-1} deg^{-1}, respectively. Upon comparison with UF_6 several anomalies appear which are discussed and partially explained in the text. The heats of sublimation and vaporization of UF_6, NpF_6, and PuF_6 are calculated from 273.15 to 350°K. Satisfactory agreement with the third law of thermodynamics is obtained from the thermodynamic data of UF_6. The heat of vaporization of UF_6 at 0°K is calculated to be 12,965 cal mole^{-1} using the value of b = -3.6×10^3 T^{-2} cal mole^{-1} (mm Hg)$^{-1}$ for the second virial-coefficient and a new assignment for the fundamental vibration frequencies of UF_6; $\nu_1 = 667$, $\nu_2 = 535$, $\nu_3 = 623$, $\nu_4 = 181$, $\nu_5 = 202$, and $\nu_6 = 140$ cm^{-1}. The vapor-pressure of UF_6 at 0°C is remeasured to be 17.65 mm in agreement with a thermodynamic calculation. (auth)

132

THE INTERACTION OF URANYL CHLORIDE WITH HYDRAZINE, AMMONIA AND AMINES. I. Kalnins and G. Gibson (Illinois Inst. of Tech., Chicago). J. Inorg. & Nuclear Chem. 11, 115-23(1959) Sept.

Solid systems of composition $UO_2Cl_2 \cdot 4N_2H_4$, $UO_2Cl_2 \cdot 3NH_3$, and $UO_2Cl_2 \cdot 2-3RHN_2$ (R = CH_3, C_2H_5, C_3H_7, and C_4H_9) were prepared. Of these only $UO_2Cl_2 \cdot 3NH_3$ is stable up to 200°C. The $UO_2Cl_2-RNH_2$ systems underwent a slow redox reaction giving UO_2, ligand hydrochloride and polymeric materials as the solid products. The polymeric materials containing carbon, nitrogen, and hydrogen appeared to be primarily polymers of alkylamine, produced from the corresponding amine by dehydrogenation. In UO_2Cl_2-n- and i-butylamine systems the amine also seems to be involved in the polymerization. In the UO_2Cl_2-t-butylamine redox reaction, isobutylene and a branched hexane or hexene were identified in the volatile products. The only oxidation products in the $UO_2Cl_2-N_2H_4$ system were non-condensable gases (N_2 and H_2). Aqueous 10 M hydrazine was found to reduce solid UO_2Cl_2, but not UO_3, to solid UO_2 at room temperature. (auth)

133

STUDIES ON MONO- AND DI-n-BUTYLPHOSPHORIC ACIDS. II. THE SOLUBILITY AND DISTRIBUTION OF MONO- AND DI-n-BUTYLPHOSPHORIC ACIDS IN AQUEOUS—ORGANIC SOLVENT SYSTEMS. C. J. Hardy and D. Scargill (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. & Nuclear Chem. 11, 128-43(1959) Sept.

The solubilities of mono- and di-n-butylphosphoric acid (H_2MBP and HDBP, respectively) at 25°C in water, aqueous nitric acid, odorless kerosene and benzene were measured using P^{32}-labeled acids. The net distribution coefficient (D_{HDBP}) for HDBP was measured as a function of the concentration of HDBP for; a number of organic solvents in contact with 1 M HNO_3, chloroform

in contact with 0.1 and 1 M perchloric acid, and the kerosene—HNO_3 system from 0 to 15 M HNO_3. In TBP-kerosene—HNO_3 systems, D_{HDBP} and $\overline{D}_{H_2MBP}$ were measured as functions of the concentrations of HDBP, H_2MBP, TBP, and HNO_3. TBP was shown to associate with both HDBP and H_2MBP. The data can be applied to the calculation of equilibrium distribution coefficients for HDBP and H_2MBP in TBP—HNO_3 systems over a range of [TBP] from 0.1 to 100% v/v in the diluent, of [HNO_3] from 0 to 15 M, and of [HDBP] and [H_2MBP] either separately or together in the range 10^{-6} to 0.05 M. The solubility and distribution data for HDBP are qualitatively interpreted in terms of a series of equations for the dissociation of HDBP, the dimerization of HDBP in both aqueous and organic phases, the association of HDBP with TBP and with HNO_3, the association of TBP with HNO_3; and the distribution of the HDBP monomer and dimer, and the HDBP·HNO_3 species, between the phases. The dimerization constants of HDBP in various organic solvents, the distribution constants of the monomer and the dimer in aqueous—organic solvent systems, and the association constant between TBP and HDBP in kerosene were calculated. (auth)

134

SPECTROPHOTOMETRIC STUDIES OF TIN(II) AND TIN(IV) DISSOLVED TOGETHER IN PURE METHANOL AND IN METHANOL—CARBON TETRACHLORIDE. P. A. D. de Maine and M. N. de Maine (New York State Univ., Albany). J. Inorg. & Nuclear Chem 11, 144-50(1959) Sept.

The ultra-violet absorption spectrum of $SnCl_4 \cdot 5H_2O$ and $SnCl_2 \cdot 2H_2O$ dissolved together in pure methanol or in methanol—carbon tetrachloride is greater than the sum of the spectra of the separate components in the same solvents. Analyses of these spectra show that the observed enhancement is entirely due to collisions between Sn(II) and Sn(IV) species. (auth)

135

HEAT OF ADSORPTION OF PARAHYDROGEN AND ORTHODEUTERIUM ON GRAPHON. E. L. Pace and A. R. Siebert (Western Reserve Univ., Cleveland). J. Phys. Chem. 63, 1398-1400(1959) Sept.

An experimental investigation of the differential and isosteric heats of adsorption for parahydrogen and orthodeuterium adsorbed on graphon has been carried out in the neighborhood of the normal boiling points of the gases by the use of conventional low temperature calorimetric procedures. Assuming the interaction of an isolated molecule of the gas with a surface having the structure and parameters of graphite, good agreement is obtained between the computed and experimental values of the heat of adsorption at low coverages. The larger heat of adsorption of deuterium as compared to that of hydrogen is reasonably explained by the difference in the zero point energies associated with the degree of freedom perpendicular to the adsorbent surface. (auth)

136

THE EFFECT OF TEMPERATURE ON ION EXCHANGE EQUILIBRIA. II. THE AMMONIUM—HYDROGEN AND THALLOUS—HYDROGEN EXCHANGES. O. D. Bonner and Robert R. Pruett (Univ. of South Carolina, Columbia). J. Phys. Chem. 63, 1417-20(1959) Sept.

Ion-exchange reactions between ammonium and hydrogen and between thallous and hydrogen ion on Dowex-50 resins of 16% DVB content have been studied over the temperature range 0 to 97.5° while maintaining a

constant solution ionic strength of approximately 0.1 M. The equilibrium constant and the standard free energy, enthalpy and entropy changes have been calculated for each exchange at each temperature. The differential free energy, enthalpy and entropy of exchange for each system is found to vary considerably with resin composition. One possible explanation of this variation is the assumption that the ion exchange resin in the hydrogen form is an acid which is similar in strength but probably slightly weaker than nitric acid. (auth)

137

THE EFFECT OF TEMPERATURE ON ION-EXCHANGE EQUILIBRIA. III. EXCHANGES INVOLVING SOME DIVALENT IONS. O. D. Bonner and Robert R. Pruett (Univ. of South Carolina, Columbia). J. Phys. Chem. 63, 1420-23(1959) Sept.

Ion-exchange equilibria in seven systems involving divalent ions have been investigated over the temperature range 0 to 97.5° using sulfonic acid type (Dowex-50) resins. In all exchanges between two divalent ions, the equilibrium constant decreases with increasing temperature, with a resulting negative value for ΔH^0. This is apparently characteristic of exchanges between ions of the same valence type since for all exchanges between two univalent ions negative ΔH^0 values have also been observed. With the exception of the cupric-magnesium system, the values of ΔS^0 for all exchanges between two divalent ions are positive. For the magnesium–hydrogen exchanges ΔH^0 and ΔS^0 are positive. The algebraic signs of these functions are identical with those of the cupric–hydrogen system already reported. (auth)

138

THE HEAT CAPACITIES OF YTTRIUM OXIDE(Y_2O_3), LANTHANUM OXIDE (La_2O_3) AND NEODYMIUM OXIDE (Nd_2O_3) FROM 16 TO 300°K. Harold W. Goldstein, E. F. Neilson, Patrick N. Walsh, and David White (Ohio State Univ., Columbus). J. Phys. Chem. 63, 1445-9(1959) Sept.

The heat capacities of the sesquioxides of yttrium, lanthanum, and neodymium have been determined in the temperature range 16 to 300°K. The entropies, enthalpies, and free energy functions have been calculated from the heat capacity data and are tabulated for several temperatures. Yttrium oxide and lanthanum oxide exhibit typical sigmoidal heat capacity curves with no anomalies in the temperature range studied. The shape of the heat capacity curve for neodymium oxide is similar except that at the lowest temperature there is evidence for the existence of an anomaly. At 298.16°K. the entropies are 23.693 ± 0.07 and 30.580 ± 0.07 cal. $mole^{-1}$ $deg.^{-1}$ for yttrium oxide and lanthanum oxide, respectively. For neodymium oxide $S_{298.16}-S_{16}$ is 33.607 cal. $mole^{-1}$ $deg.^{-1}$. The free energy functions have been extended to 2500°K. by the use of some higher temperature heat capacity data available in the literature. (auth)

139

THE PREPARATION OF URANIUM MONOCARBIDE AND ITS HEAT OF FORMATION. John D. Farr, Elmer J. Huber, Jr., Earl L. Head, and Charles E. Holley, Jr. (Los Alamos Scientific Lab., N. M.). J. Phys. Chem. 63, 1455-6(1959) Sept.

The preparation of uranium monocarbide, UC, by direct combination of the elements is described. Its heat of formation was found by combustion calorimetry to be $\Delta H^0_{298°K} = -21.0 \pm 1.0$ kcal/mole. The combustion

experiments were done with $UC-UO_2$ mixtures in order that the final uranium oxide formed would be stoichiometric U_3O_8. (auth)

140

VOLUME EFFECTS ON MIXING IN THE LIQUID $Bi-BiI_3$ SYSTEM. F. J. Keneshea, Jr., and Daniel Cubicciotti (Stanford Research Inst., Menlo Park, Calif.). J. Phys. Chem. 63, 1472-4(1959) Sept.

Volume effects on mixing in the liquid $Bi-BiI_3$ system have been determined by measurements of the density as a function of temperature. The total volume of the system decreases on mixing. The partial molar volume of BiI_3 differs only slightly from the molar volume of the pure salt while the partial molar volume of the bismuth is much less than the molar volume of pure bismuth. These volume effects are analogous to the changes found previously for the bismuth–chloride and bismuth–bromide systems and are interpreted in terms of the same model of an interstitial type of solution. The experimental values in all three halide systems are in fair agreement with an expression derived from the model which relates the partial molar volume of the bismuth with the halide ion radius.

141

THE SURFACE PROPERTIES OF LIQUID LEAD IN CONTACT WITH URANIUM DIOXIDE. D. H. Bradhurst and A. S. Buchanan (Univ. of Melbourne). J. Phys. Chem. 63, 1486-88(1959) Sept.

The sessile drop technique has been used to measure surface tensions and contact angles of liquid lead on uranium dioxide surfaces. The influence on these properties of the metallic solute bismuth and the non-metallic solutes oxygen, sulfur, selenium, and tellurium has been investigated. Oxygen is clearly the most effective in reducing the surface tension and contact angle of the molten lead. (auth)

142

THE KINETICS OF THE REACTION BETWEEN Pu(IV) AND U(IV). T. W. Newton (Los Alamos Scientific Lab., N. Mex.). J. Phys. Chem. 63, 1493-97(1959) Sept.

The kinetics of the reaction between Pu(IV) and U(IV) have been studied in perchlorate media. The rate law indicates that the activated complex is formed from water, U^{+4} and Pu^{+4} with the prior loss of two hydrogen ions. Minor paths involving other activated complexes appear unlikely. The thermodynamic quantities of activation in 2 $\underline{M}$ $HClO_4$ solutions at 25° were found to be $\Delta F\ddagger = 15.4$ kcal/mole, $\Delta H\ddagger = 24.3$ kcal/mole and $\Delta S\ddagger = 30.1$ e.u. The relation between the kinetics of this reaction and similar ones is discussed. It was found that the presence of small amounts of H_2SO_4 greatly increases the rate of the reaction. (auth)

143

THE KINETICS OF THE REACTION BETWEEN PLUTONIUM(VI) AND TITANIUM(III) IN PERCHLORATE SOLUTION. S. W. Rabideau and R. J. Kline (Los Alamos Scientific Lab., N. Mex.). J. Phys. Chem. 63, 1502-5(1959) Sept.

The kinetics of the reaction between Pu(VI) and Ti(III) have been studied as functions of temperature and acidity using spectrophotometric methods. Since the reductions of Pu(VI) and Pu(IV) by Ti(III) are measurable, whereas the reduction of Pu(V) is very rapid, the data were treated as competitive consecutive second-order reactions. The rate law written in terms of the rate of disappearance of Pu(VI) is $-d[Pu(VI)]/dt = k_1[Pu(VI)]$

$[Ti(III)][H^+]^{-1}$. The inverse first power of the hydrogen ion concentration in the rate law suggests that the slow step may consist of the reaction, $PuO_2^{++} + TiOH^{++} \rightarrow PuO_2^+ + TiO^{++} + H^+$. With values of the specific rate constant for the reaction between Pu(IV) and Ti(III) obtained from independent experiments, the spectrophotometric data were coded for the IBM-704 computer and the calculation was made using an iterative procedure to evaluate the specific rate constant for the reaction between Pu(VI) and Ti(III). At 25° in molar perchloric acid, the rate constant for the Pu(VI)-Ti(III) reaction was found to be 108 sec⁻¹. The reduction of perchlorate ion by Ti(III) has been considered, and it has been shown that reductions of Pu(VI) and Pu(IV) by Ti(III) are not catalyzed by chloride ion. The thermodynamic quantities for the activation process written in terms of the principal species are $\Delta F\ddagger = 14.7 \pm 0.01$ kcal/mole, $\Delta H\ddagger = 10.3 \pm 0.4$ kcal/mole and $\Delta S\ddagger = -14.7 \pm 1.3$ e.u. (auth)

144

THE RATE OF REACTION OF HYDROGEN WITH THORIUM. D. T. Peterson and D. G. Westlake (Iowa State Coll., Ames). J. Phys. Chem. 63, 1514-16(1959) Sept.

The reaction between thorium and hydrogen, which produced a surface layer of thorium dihydride, was shown to follow the parabolic rate law. At pressures slightly greater than the dissociation pressure of the dihydride, the absorption rate was very dependent on the pressure, but at higher pressures the pressure dependency was less pronounced. Increasing the temperature accentuated the pressure dependency of the absorption rate at the higher pressures. The temperature dependence of the absorption rate satisfied an Arrhenius type equation at temperatures below 550° when the pressure was held constant at 120 mm. The activation energy for diffusion was found to be about 19.6 kcal. The absorption rate was the same for annealed thorium of two purity levels and for cold-swaged thorium. (auth)

145

ELECTRICAL CONDUCTIVITIES OF KCl−KBr SOLID SOLUTIONS. John E. Ambrose and W. E. Wallace (Univ. of Pittsburgh). J. Phys. Chem. 63, 1536-7(1959) Sept.

Data are given on electric conductivity of three KCl−KBr solid solutions at 400 to 540°C and on pure KCl and KBr. The study was made to obtain information on the vacancy population at or near room temperature. No indication of an abnormal vacancy population is given. (T.R.H.)

146

TRITIUM-LABELED COMPOUNDS. II. GENERAL-PURPOSE APPARATUS, AND PROCEDURES FOR THE PREPARATION, ANALYSIS, AND USE OF TRITIUM OXIDE AND TRITIUM-LABELED LITHIUM BOROHYDRIDE. Horace S. Isbell and Joseph D. Moyer. J. Research Natl. Bur. Standards 63A, 177-83(1959) Sept.-Oct.

A general-purpose manifold is described, which is useful for numerous procedures involving tritium gas and tritium-labeled materials. Methods are given in detail for converting tritium gas to tritium oxide, preparing tritium-labeled lithium borohydride, and conducting a variety of reactions in a closed system. Auxiliary equipment is shown, including water traps, reaction flasks, and apparatus for preparing solutions and making filtrations in closed systems. Methods are presented for assaying tritium-labeled water by dissolving it in a phosphoric anhydride-sulfuric acid solution and counting in a windowless, gas-flow, proportional counter, or converting it to hydrogen-t and assaying it in an ionization chamber. The use of tritium-labeled lithium borohydride is illustrated by the preparation of D-galactitol-1-t from D-galactose. (auth)

147

THE COMPOSITION AND STABILITY OF THE SULFATE COMPLEX OF ZIRCONIUM. V. F. Saksin. Nauch. Doklady Vysshei Shkoly. Khim. i Khim. Tekhnol., No. 1, 75-9(1959).

It is known from publications that anion complexes of zirconium as well as positively charged complexes, e.g., $[ZrO(H_2O)(OH)]^+$ may be formed in a solution of sulfuric acid. In the present paper the formation of positive zirconyl complexes with an excess of ZrO^{2+}-ions is investigated. 1) The solubility of $BaSO_4$ in zirconyl nitrate at 20° and the composition of the bottom phase were investigated. 2) Zirconyl nitrate was titrated with a 0.05 molar Na_2SO_4 solution and the precipitate was analyzed. 3) The pH in this titration lye was measured; the pH was determined in solutions to which 0.2-n HNO_3 was added until the precipitate dissolved. 4) The solubility of $BaSO_4$ in KNO_3 solutions and KNO_3 solutions acidified with HNO_3 was investigated in order to investigate salt effects. The solubility of barium sulfate in zirconyl nitrate can neither be explained by salt effects nor by the influence of the free acid formed in the hydrolysis of zirconyl nitrate. It is a matter of formation of zirconyl complex salts which takes place according to the following equations: (1) $BaSO_4 + ZrO^{2+} + nH_2O \rightleftharpoons [(ZrO(SO_4)H_2O)_n]^0 + Ba^{2+}$ and (2) $BaSO_4 + 2ZrO^{2+} \rightleftharpoons [(ZrO_2)SO_4]^{2+} + Ba^{2+}$ Since a ZrO^{2+} excess was used, the dissolution of barium sulfate had to take place mainly according to equation 2. The titration showed also that the precipitate dissolved in the zirconyl nitrate excess. A dissolution of the precipitate in free nitric acid does not occur before a high acid concentration is attained. The complex ion has the formula $[(ZrO_2)SO_4]^{2+}$. With lower concentrations of zirconyl nitrate other complexes appear, e.g., the neutral $[ZrO(SO_4)(H_2O)_n]^0$. With still lower concentrations of zirconyl nitrate complex formation stops and zirconium is found in the bottom phase. The formation of anion complexes of the type $[Zr(SO_4)]^{4-2n}$ was not found. The absence of these complexes was indicated by the rapid decrease of the solubility of barium nitrate in zirconyl nitrate after the addition of nitric acid. Nitric acid suppresses the hydrolysis of zirconyl nitrate; tetravalent Zr ions are formed which obviously do not form complexes with SO_4^{2-} ions and therefore cannot dissolve barium sulfate. The computed instability constant $K_n = 1.88 \times 10^{-9}$ maintained its value independent of the experimental conditions. A slight decrease of the value with a very low zirconyl nitrate concentration seems to be due to the formation of the neutral complex according to equation 1. (TCO)

148

THE FORMATION OF COMPLEX COMPOUNDS OF NEODYMIUM AND YTTERBIUM WITH ETHYLENEDIAMINE TETRAACETIC ACID ON CATION-EXCHANGE CHROMATOGRAPHY. L. I. Martynenko. Nauch. Doklady Vysshei Shkoly, Khim. i Khim. Tekhnol., No. 1, 84-88(1959).

The washing out of neodymium and ytterbium ions by

means of ethylenediamine tetraacetic acid (abbreviated H_4A) is observed on a cation exchanger on the basis of synthetic resin. With neodymium H_4A is retained in the resin. The analysis of the compound eluted from the resin showed the complex acid $H(NdA)$ and its salt, respectively. Since the hexahydrate of this acid shows good solubility, the retention of H_4A cannot be due to the crystallization of the acid in the resin. In this case the rate of elution was too high. Crystals of the complex acid readily tending towards supersaturation did not separate before hours had passed after the emergence from the column. Neodymium is adsorbed in the resin in the form of the "autosalt" $Nd(NdA)_3$. In the elution with water a desorption takes place, while the "auto-salt" again enters reaction in an unchanged form. The process in the individual resin layers is different; thus the concentration fluctuations of H_4A depending on the length of the adsorption column can be explained. The special tendency of $Nd(NdA)_3$ towards adsorption is to be explained by a further investigation. With ytterbium no concentration fluctuations appear in the extract, the complex compound between Yb^{3+} and H_4A obviously has no special tendency towards adsorption. This difference in the behavior of the complex compounds of neodymium and ytterbium offers an opportunity of separating the two elements by ion exchange. (TCO)

149

DIFFUSION COEFFICIENT OF ^{37}A IN LIQUID N_2. G. Cini-Castagnoli and F. Dupré (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome) and F. P. Ricci (Comitato Nazionale Ricerche Nucleari, Rome). Nuovo cimento (10) 13, 464-5(1959) July 16.

The diffusion coefficients for Ar^{37} in N_2 (concentration of Ar^{37} in N_2 was about 10^{-7}%) were determined to be $2.10 \ (cm^2/s) \times 10^5$ at $73.4°K$ and $1.90 \ (cm^2/s) \times 10^5$ at $71.7°K$. (C.J.G.)

150

ON THE POSSIBILITY OF RECOMBINATION PROCESSES IN THE LUMINESCENCE OF TUNGSTATE AND URANYL COMPOUNDS. V. L. Levshin, V. B. Guman, and E. N. Karzhavina. Optics and Spectroscopy (English Translation) 6, 234-6(1959) Mar.

The decay of luminescence excited in uranyl silicate and calcium tungstate by cathode rays and by light was investigated. Besides the usual luminescence, which decays exponentially, there was observed a thermoluminescent emission corresponding to the liberation of electrons from the trapping levels. The formation and breakdown of the trapping levels were investigated. The process observed is insignificant under photoexcitation, but is very marked under cathode excitation. (auth)

151

DETERMINATION OF THE LUMINESCENCE QUANTUM YIELD OF THE TRIVALENT TERBIUM ION IN SOLUTION. E. V. Kondrat'eva. Optics and Spectroscopy (English Translation) 6, 269-70(1959) Mar.

Relative intensities were measured for the seven bands of the luminescence spectrum of aqueous solutions of terbium chloride and sulfate. It is concluded that the probability of a radiationless transition for Tb^{3+} in aqueous solution is approximately two orders of magnitude greater than for radiation transition. (C.J.G.)

152

ISOTOPIC EXCHANGE OF S^{35} BETWEEN N-ALKYL-THIOUREAS AND N-ALKYL-FORMAMIDINE-DISULFIDES. Ferruccio d'Angeli and Antonio Iliceto

(Centro di studio per la chimica nucleare, Padua). Ricerca sci. 29, 1687-90(1959) Aug. (In Italian)

A very fast isotopic exchange of sulfur atoms has been found to occur between N-alkyl-thioureas and N-alkyl-formamidine-disulfides. The exchange is so fast as to go to completion within the time required for the separation of the reagents. The exchange reaction can be reasonably interpreted as an exchange of thioureic groupings, arising from a direct displacement of one thiourea molecule at one of the sulfur atoms of the disulfide. (auth)

153

SPECIFIC HEAT OF CHROMIUM BORIDE. A. N. Krestovnikov and M. S. Vendrikh. Sbornik Nauch. Trudov Moskov. Inst. Tsvetnoi Met. i Zolota, Nauch. Tekh. Obshchestva Tsvetnoi Met., No. 30, 135-7(1957). (Translated from Referat. Zhur. Met., No. 10, 1958, p.144).

The mean specific heat of CrB_2 was determined on a water calorimeter set for the temperature range from room temperature to 300, 400, 500, 600, 700, and 800°C. On the basis of the data obtained an equation for the relationship of specific heat to temperature was developed by the method of least squares. An equation for the true specific heat capacity, was also obtained.

154

REACTION HEAT OF OXIDATION OF SOME ELEMENTS DURING THE BLOWING OF OXYGEN OR AIR THROUGH MOLTEN METAL. V. A. Fuklev. Trudy Sredneaziat. Politekh. Inst., No. 4, 201-15(1957). (Translated from Referat. Zhur. Met., No. 2, 1959, p.20).

Equations for the reaction heats of oxidation of Fe, Mn, Si, and C in relation to the temperature were developed according to data on the specific heats, heats of solution, and heats of phase transformations.

155

THE GRAPHITIZATION OF CARBON. I. GRAIN SIZE, CRYSTAL STRUCTURE, AND SPECIFIC WEIGHT. O. Hauser (Zentralinstitut für Kernphysik, Dresden). Z. physik. Chem. (Leipzig) 209, 335-51(1958) Oct. (In German)

The graphitization of soot in comparison with petroleum coke was investigated. The grain size and shape, the crystal structure, and the specific weight are changed by the thermal treatment. The principal differences between the "bad graphitization" of soot and the "good graphitization" of petroleum coke were indicated. In the soot the turbostratic modification predominates after high temperature treatment, but in the petroleum coke after treatment at temperatures over 2000°C the turbostratic modification is transformed into the hexagonal modification. (tr-auth)

156

ADVANCES IN INORGANIC CHEMISTRY AND RADIO-CHEMISTRY. H. J. Emeleus and A. G. Sharpe, eds. New York, Academic Press Inc., 1959. 453p.

Progress in the fields of inorganic chemistry and radiochemistry are reported up to January, 1959. The topics covered include; mechanisms of redox reactions of simple chemistry, compounds of aromatic ring systems and metals, studies on boron hydrides, lattice energies in inorganic chemistry, graphite intercalation compounds, Szilard-Chalmers reaction in solids, activation analysis, phosphonitrilic halides and their derivatives, and sulfuric acid solvent system. (C.J.G.)

Analytical Procedures

157   AERE-AM-19
United Kingdom Atomic Energy Authority. Research
   Group. Chemistry Div., Woolwich Outstation,
   England.
THE DETERMINATION OF SUBMICROGRAM QUANTI-
TIES OF PLUTONIUM 239. G. J. Hunter and R. B.
Chenley. July 1959. 8p. BIS.

   Plutonium fluoride and lanthanum fluoride are co-
precipitated and mounted on a stainless steel disk. The
precipitate is then α-counted. The aliquot of solution
to be analyzed should not contain more than 1 g of ura-
nium. The smallest amount of plutonium that can be
determined is dependent on the background of the
counter; this background can be as low as 3 counts per
hour (about 8 disintegrations per hour of plutonium) if
an α-scintillation counter is used. The method has a
negative bias of 2.5%. The coefficient of variation, when
counting statistics permit, is 2%. (auth)

158   AERE-AM-23
United Kingdom Atomic Energy Authority. Research
   Group. Chemistry Div., Woolwich Outstation,
   England.
THE FLAME PHOTOMETRIC DETERMINATION OF
STRONTIUM TO CALCIUM RATIOS IN MILK AND
VEGETATION ASHES. R. J. Webb and P. C. Wildy.
July 1959. 6p. BIS.

   Calcium—strontium oxalate fractions precipitated
from the ash of milk or vegetations are dissolved in
dilute hydrochloric acid to form a 0.1% solution with
respect to calcium. The strontium to calcium ratio is
determined directly by use of a flame photometer of
special design. The range covered is from 50 to 10,000
ppm of strontium in calcium. The coefficient of varia-
tion at the 100 ppm level is 2%, and there is no ob-
served bias. (auth)

159   AERE-AM-48
United Kingdom Atomic Energy Authority. Research
   Group. Chemistry Div., Woolwich Outstation,
   England.
THE DETERMINATION OF BORON IN METHYL ALCO-
HOL DISTILLATES. G. S. Spicer. July 1959. 9p.
BIS.

   The distillate is mixed with water, sodium hydroxide,
and glycerol and evaporated to dryness. After ignition
the boron is determined colorimetrically by its reaction
with curcumin. This method is applicable to pure dis-
tillates of methanol of less than 150 ml in volume.
About 2 to 25 μg is a suitable quantity of boron for de-
termination, and the limit of detection is 0.05 μg. In the
above range the error should not exceed $\pm 2\%$. (auth)

160   AERE-AM-53
United Kingdom Atomic Energy Authority. Research
   Group. Chemistry Div., Chatham Outstation, Kent,
   England.
THE DETERMINATION OF COPPER IN BERYLLIUM
COMPOUNDS (FLUORIDE, HYDROXIDE AND AMMO-
NIUM FLUORBERYLLATE). J. Walkden. Aug. 1959.
6p. BIS.

   Solutions of the samples are fumed with sulfuric acid
to remove fluoride and the residues are dissolved in
water. After addition of citric acid and excess ammonia
ethylenediaminetetraacetic acid is added followed by a
solution of sodium diethyldithiocarbamate. The copper
is estimated absorptiometrically after extraction of the
diethyldithiocarbamate complex into chloroform. The

method is suitable for the determination of 2 to 80 ppm
of copper in beryllium fluoride and 1 to 40 ppm in
beryllium hydroxide and ammonium fluoberyllate. Ex-
cept at the lower levels the error should not exceed
$\pm 5\%$. (auth)

161   AERE-AM-55
United Kingdom Atomic Energy Authority. Research
   Group. Chemistry Div., Chatham Outstation, Kent,
   England.
THE DETERMINATION OF CHROMIUM IN BERYL-
LIUM COMPOUNDS (FLUORIDE, HYDROXIDE AND
AMMONIUM FLUORBERYLLATE). J. Walkden. July
1959. 6p. BIS.

   To the solution of the sample, boric acid is added to
complex the fluoride ion and chromium is oxidized to
chromate by potassium permanganate and determined
absorptiometrically after formation of the complex with
diphenylcarbazide. The method is suitable for the de-
termination of chromium contents from 1 to 100 ppm.
Except at the lower levels the error should not exceed
$\pm 5\%$. (auth)

162   AERE-C/R-2666
United Kingdom Atomic Energy Authority. Research
   Group. Chemistry Div., Woolwich Outstation,
   England.
THE DETERMINATION OF TELLURIUM IN BISMUTH
METAL. F. E. Wild. July 1959. 17p. BIS.

   A method has been developed for the determination of
tellurium in bismuth metal which depends on the reduc-
tion of the tellurium by hydrazine and stannous chloride
followed by filtration and either absorptiometric or
volumetric determination. With the absorptiometric
method the limit of detection on a 1 g sample is 5 ppm
and the coefficient of variation is 3% at the 50 ppm
level. A volumetric finish may be used for tellurium
contents above 0.5%. The method should be applicable
to materials other than bismuth. (auth)

163   AERE-HP/R-2858
United Kingdom Atomic Energy Authority. Research
   Group. Atomic Energy Research Establishment,
   Harwell, Berks, England.
TRITIUM IN URINE MONITORING BY THE ACETY-
LENE FLOW ION CHAMBER METHOD. R. M. Fry.
July 1959. 13p. BIS.

   Using a 2 liter ion chamber enclosed in a 2 in. lead
castle and a stable vibrating reed electrometer, the
limit of detection of an acetylene flow method of meas-
uring tritium in aqueous solution has been found to be
0.001 $\mu c/ml$. Concentrations of 0.05 $\mu c/ml$ can be
measured to a relative accuracy of about $\pm 10\%$ in a
quarter of an hour. Commercial acetylene is used as
the flushing gas and for background determination.
Radon present in the calcium carbide introduces a con-
stant zero error. (auth)

164   AERE-M-444
United Kingdom Atomic Energy Authority. Research
   Group. Atomic Energy Research Establishment,
   Harwell, Berks, England.
THE SEPARATION OF NEPTUNIUM AND PLUTONIUM
BY ION EXCHANGE. N. Jackson and J. F. Short. July
1959. 8p. BIS.

   Plutonium and neptunium, after reduction to PuIII and
NpIV by ammonium iodide in concentrated hydrochloric
acid, can be separated on a Deacidite FF anion exchange
column. The neptunium is eluted from the column by $2\underline{M}$
HCl. Both elements were recovered in 100% yield.
(auth)

165   AERE-R-2867

United Kingdom Atomic Energy Authority. Research
    Group. Atomic Energy Research Establishment,
    Harwell, Berks, England.

THE DETERMINATION OF TRITIUM AS WATER VA-
POUR IN A GEIGER-MÜLLER COUNTER. R. M. Fry.
July 1959. 19p. BIS.

The concentration of tritium in water and in heavy
water has been determined by the method due to Cam-
eron. Tritiated water vapor is mixed with the filling
gas of a Geiger-Mueller counter. A concentration of
0.02 μc/g of tritium as HTO can be determined with an
accuracy of better than 10% in a counting period of 60
min. The system is calibrated using a standard solution
of tritium in light water. The limitations of the system
as an absolute method are considered. In the case of
tritium in heavy water, there is some additional error
due to uncertainty in isotopic fractionation. (auth)

166   HW-55349

General Electric Co. Hanford Atomic Products Opera-
    tion, Richland, Wash.

TURBIDIMETRIC MICRODETERMINATION OF SUL-
FATE IN PLUTONIUM SOLUTIONS. H. D. Warren and
A. Brunstad. Mar. 14, 1958. 6p. Contract W-31-109-
Eng-52. OTS.

The basis of this procedure is the removal of pluto-
nium with a cation exchange resin, followed by forma-
tion of a barium sulfate suspension and measurement of
the optical density of the suspension with a spectro-
photometer. It can be used for sulfate in the concentra-
tion range 0.02 to 10 $\underline{M}$ using a 50 microliter sample.
With a larger sample, the lower limit could be extended.
The precision expressed as the standard deviation of a
single result is approximately ±3 percent. Accuracy,
based on the analysis of known standards, is about ±2.5
percent. Plutonium present in a five-fold molar excess
does not interfere with the analysis. (auth)

167   JEN-1

Spain. Junta de Energia Nuclear, Madrid.
CONTRIBUCIÓN AL ESTUDIO DEL MÉTODO Y FAC-
TORES QUE AFECTAN A LA DETERMINACIÓN
ESPECTROFOTOMÉTRICA DE TRAZAS DE BORO
CON CARMÍN EN COMPUESTOS DE URANIO. (Con-
tributions to the Safety of Methods and Factors Affect-
ing the Spectrophotometric Determination of Boron
Traces with Carmin in Uranium Compounds). R. Fer-
nandez Cellini and L. Gasco Sanchez. 1956. 16p.

A study is made of some factors affecting the spec-
trophotometric determination of boron traces with
carmin. The influence of the carmin origin, the stabil-
ity of the carmin-boric acid complex with respect to the
sulfuric acid concentration, the interference produced
by nitrate ions, and the effects of uranyl ions and light
are discussed. (tr-auth)

168   JEN-11

Spain. Junta de Energia Nuclear, Madrid.
APLICACION DE LA COMPLEXONA III Y RESINAS
CAMBIADORAS A LA DETERMINACIÓN COLORI-
METRICA CON ORTO-FENANTROLINA DE TRAZAS
DE HIERRO EN COMPUESTOS DE URANIO. (Uses of
Complexone III and Ion Exchange Resins in Colorimetric
Determination with O-Phenanthroline of Fe Traces in
Uranium Compounds). R. Fernandez Cellini and
F. Ruiz Sanchez. 1959. 17p.

The colorimetric determination of small quantities of
iron with o-phenantroline assumes the elimination of
cation interference by the control of the pH before the

formation of the colored complex. This difficulty was
overcome by the combined use of complexone-III and
ion exchange. The complexone forms an iron chelate
with a stability constant high enough to permit the pas-
sage of an iron solution through a cation exchange col-
umn without being fixed. Mercury, the only element
with a similar stability, is eliminated prior to the pas-
sage through the exchange column. The complex with
o-phenantroline is formed preferentially, and therefore
the iron is displaced from the complexone complex.
The effect of pH and the concentration of complexone on
the appearance of the coloration is studied. The lower
limit for the determination is 0.5 γ of Fe/15 cc solu-
tion. (tr-auth)

169   LA-1839(Del.)

Los Alamos Scientific Lab., N. Mex.
DETERMINATION OF THORIUM IN PLUTONIUM-
THORIUM ALLOYS. Karl S. Bergstresser and
Maynard E. Smith. Sept. 1954. Decl. with deletions
Oct. 5, 1956. 25p. Contract W-7405-eng-36. OTS.

A spectrophotometric method used in the determina-
tion of thorium was modified for the purpose of analyz-
ing plutonium alloys which contained 0.01 to 0.8% tho-
rium. Absorbance values were measured at 545 mμ for
solutions containing thorium and thorin, the organic
reagent added to form a colored complex with thorium
in the presence of plutonium(III). With plutonium-
thorium solution samples, equivalent to dissolved alloys
containing 0.2 to 0.8% thorium, the average recovery of
thorium was 99.6 ± 1.5%. For similar samples contain-
ing 0.01 to 0.2% thorium, the average recovery was
101.0 ± 3.4%, after the thorium was separated from
plutonium by precipitation of thorium fluoride with the
aid of lanthanum fluoride as a carrier. (auth)

170   LA-1844

Los Alamos Scientific Lab., N. Mex.
THE COLORIMETRIC DETERMINATION OF BORON
IN ZIRCONIUM HYDRIDE. Glenn R. Waterbury and
Charles F. Metz. July 1954. Decl. Sept. 29, 1959.
35p. Contract W-7405-eng-36. OTS.

The quantitative estimation of submicrogram amounts
of boron in zirconium hydride using a colorimetric pro-
cedure is described. Solution of the sample in sulfuric
acid or hydrofluoric acid and subsequent distillation of
methyl borate without boron loss or contamination is
shown to be possible. Using the curcumin color reac-
tion, quantities of boron as low as 0.01 microgram can
be detected. The method should apply equally well to
zirconium metal and compounds, providing they can be
dissolved under conditions that do not result in loss of
boron and if the resulting solution will permit the quan-
titative removal of boron by distillation as methyl
borate. (auth)

171   NAA-SR-4005

Atomics International Div., North American Aviation,
    Inc., Canoga Park, Calif.
SPECTROPHOTOMETRIC DETERMINATION OF
COBALT IN SODIUM METAL. Louis Silverman and
Rachel L. Seitz. Oct. 15, 1959. 14p. Contract AT-
11-1-GEN-8. OTS.

A colorimetric method, using 2-nitroso-1-naphthol,
is outlined for determining cobalt in sodium metal,
which is used as a coolant in nuclear reactors. The
sodium metal is reacted with water, neutralized with
hydrochloric acid, and the cobalt content determined;
the cobalt nitrosonaphtholate is extracted with carbon
tetrachloride and the absorbance is measured at 535

mμ. Chloride ion is requisite for the extraction of the cobalt complex in dilute solutions. Lithium and potassium, as well as sodium, have no effect. Ammonium ions have an adverse effect. As little as 0.1 ppm cobalt can be determined in sodium metal. In order to determine cobalt in the fractional ppm range, 10 gm of sample are used. The molar extinction coefficient is 11,780. (auth)

172   ORNL-2852
Oak Ridge National Lab., Tenn.
ISOTOPE SEPARATION AND ISOTOPE EXCHANGE. A Bibliography with Abstracts. G. M. Begun. Oct. 28, 1959. 239p. Contract W-7405-eng-26. OTS.

The unclassified literature covering 2498 reports from 1907 through 1957 has been searched for isotopic exchange and isotopic separation reactions involving U and the lighter elements of the periodic chart through atomic number 30. From 1953 to 1957, all elements were included. Numerous references to isotope properties, isotopic ratios, and kinetic isotope effects were included. This is a complete revision of TID-3036 (Revised) issued June 4, 1954. An author index is included. (auth)

173   TID-7533
New Brunswick Lab., AEC, N. J.
MINUTES OF THE YTTRIUM ANALYTICAL CONFERENCE, [HELD AT ARGONNE NATIONAL LABORATORY], NOVEMBER 7-8, 1956. C. J. Rodden, comp. Jan. 1957. Decl. Oct. 1, 1959. 108p. OTS.

Analytical methods for Y, yttrium oxides, rare earth mixtures, and oxides are discussed. Emphasis is placed on determination of rare earth oxides, yttrium oxides, rare earths, oxygen, and yttrium by mass spectrometric, spectrographic, neutron activation, and x-ray fluorescence methods. Several procedures for separation of rare earths and rare earth oxides are included as well as methods for impurities in Y and Y_2O_3. (J.R.D.)

174   USNRDL-TR-362
Naval Radiological Defense Lab., San Francisco.
THE CERIMETRIC DETERMINATION OF MOLYBDENUM IN HIGH CHLORIDE MEDIA USING THE MOLYBDENUM BLUE REACTION. C. M. Callahan, S. C. Foti, and J. R. Lai. Sept. 14, 1959. 13p.

A new volumetric method of determining molybdenum in a high chloride media is described. After passage through a Jones reductor the reduced molybdenum is caught under a receiver solution of sodium molybdate whose pH is so adjusted that an equivalent amount of molybdenum blue is formed. The molybdenum blue is then titrated to a colorless equivalence point with standard ceric sulfate solution. The formation of molybdenum blue serves two purposes: the oxidation-reduction reaction between Mo(III) and Mo(VI) forms an intermediate oxidation state that is stable against air oxidation and the intermediate oxidation state, molybdenum blue, serves as its own indicator in the titration. The results obtainable by this method are comparable to those obtained by the use of the permanganate method in sulfuric acid. (auth)

175   WAPD-CTA(GLA)-617-1
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
THE DETERMINATION OF TANTALUM IN NIOBIUM WITH THE APPLIED RESEARCH LABORATORY'S X-RAY FLUORESCENT MONOCHROMATOR. R. Burton, R. M. Jacobs, and E. R. Valecko. July 10, 1958. 7p. OTS.

The fluorescent x-ray determination of tantalum in niobium is described. A concentration range of 0.05 to 0.70% is covered. The oxide-cellulose pellet is placed in the sample holder and the surface irradiated. The fluorescent x radiation from the pellet is dispersed and the integrated intensity of the analytical line is compared to that of a non-dispersed beam from an external standard. The recorded intensity ratios are referred to an appropriate analytical curve to obtain the tantalum concentration. (auth)

176   AEC-tr-3866
THE DETERMINATION OF NITROGEN IN NITROCELLULOSE BY A PHOTOMETRIC METHOD. Tetsuro Murakami and Eizen Ishii. Translated for Los Alamos Scientific Lab. from Bunseki Kagaku 8, 257-9(1959). 6p. JCL.

A method in which polymerized nitrocellulose samples are dissolved in sulfuric acid and determined colorimetrically is described. It is less sensitive than the phenol method but cellulose does not interfere. (J.R.D.)

177   AERE-Trans-829
SPECTRAL ANALYSIS BY THE EVAPORATION METHOD. (REVIEW). L. V. Lipis. Translated by D. H. Bolton (U.K.A.E.A. Atomic Energy Research Establishment) from Zavodskaya Lab. 24, 736-45(1958). 18p.

The evaporation method is particularly useful in the analysis of pure materials. It was developed primarily for the analysis of heavy metals with complex spectra but has also been successfully used for the analysis of elements with relatively simple spectra (aluminum, calcium, beryllium, etc.). In these cases also the sensitivity has been raised hundreds or thousands of times by separating the impurities from the base. Recent studies have shown that the scope of the method can be widened by volatilizing the base and leaving the impurities as a condensate. Although the accuracy of this form of the method is lower than usual, it is useful in the determination of impurities in semi-conductors, where the sensitivity must be raised to 10^{-6} to $10^{-7}\%$. Methods of increasing the volatility of the impurities being determined also widen the applicability of the evaporation method. 48 references. (auth)

178   CEA-tr-A-598
LE DOSAGE POLAROGRAPHIQUE DU LITHIUM, DU RUBIDIUM ET DU CÉSIUM. (Polarographic Determination of Lithium, Rubidium, and Cesium). G. Schoberg and V. Gutmann. Translated into French from Mikrochim. Acta 319-20(1958). 4p.

Very pure EtOH or MeOH can be used in the polarography of Li for curves which permit precise measurements. For Rb and Cs an 80% solution of isopropanol can be used with tetraethylammonium hydroxide. (T.R.H.)

179   CEA-tr-R-709
MÉTHODE ACCÉLÉRÉE POUR LE DOSAGE DU RUBIDIUM DANS LES MINÉRAUX SILICATES. (Accelerated Method for the Determination of Rubidium in Silicate Minerals). E. Burkser and T. G. Kornienko. Translated into French from Ukrain. Khim. Zhur. 24, 375-8(1958). 10p.

A fast, simple method for determining Rb in natural products using Rb^{86} is given. An Rb-containing mixture of alkali metal chlorides is separated from the mineral and treated with alcohol solution saturated with HCl and diluted with 20 vol. % H_2O to extract Rb. The Rb is then precipitated by 40% alcoholic $SnCl_4$ and weighed as

Rb_2SnCl_6. The Rb losses are accounted for by measuring the activity of the Rb_2SnCl_6 and comparing it to the activity of a standard sample containing the same amount of Rb^{86} as there was Rb in the starting sample. (T.R.H.)

180   CEA-tr-R-715

DOSAGE DES ÉLÉMENTS U, Th, Pb, Ta, Hf, Zr, Y ET Sr DANS LES MINERAIS ET MINÉRAUX PAR LA MÉTHODE RADIOSPECTROSCOPIQUE. (Determination of the Elements U, Th, Pb, Ta, Hf, Nb, Zr, Y, and Sr in Ores and Minerals by the Radiospectroscopic Method). K. I. Narbutt (Narboutt) and I. D. Bespalova. Translated into French by B. de Trezvinsky from Zavodskaya Lab. 24, 617-19(1958). 10p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 2782.

181   CEA-tr-X-141

EMPLOI DES ÉCHANGEURS D'IONS EN CHIMIE ANALYTIQUE. IV. SÉPARATION DU FER ET DE L'ALUMINIUM SUR L'ÉCHANGEUR ANIONIQUE OAL. (Use of Ion Exchangers in Analytical Chemistry. IV. Separation of Iron and Aluminum on the Anion Exchanger OAL). I. Kulčickyj and F. Sácha (Svacha). Translated into French from Chem. listy 52, 340-2(1958). 8p.

The use of the strongly basic anion exchanger OAL to separate Al and Fe for determination is described. The Fe is adsorbed from a concentrated HCl solution and the Al passes to the filtrate. After washing the Fe is eluted with 0.1 $\underline{N}$ HCl. The Al and Fe can then be determined by existing methods. The column used was 8 mm i.d. glass tubing 35 cm. long containing 15 cc of OAL of particle size 0.3 to 0.5 mm. (T.R.H.)

182

RECORDING COLORIMETER FOR MICROCHEMICAL DETERMINATIONS. A. K. Solomon and David C. Caton (Harvard Medical School, Boston). Anal. Chem. 30, 291-3(1958) Feb.

A recording colorimeter has been designed and built to make rapid and accurate determinations of light absorption in samples containing 30 cu mm of fluid. The accuracy obtainable with the instrument at a wave length of 4760 A is about 1% at absorbances in the 0.1 region and 0.2% at absorbances in the 0.4 region. Five samples and a blank can be measured and recorded in less than 200 seconds. (auth)

183

X-RAY FLUORESCENCE ANALYSIS OF STAINLESS STEEL IN AQUEOUS SOLUTIONS. R. W. Jones and R. W. Ashley (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Anal. Chem. 31, 1629-31(1959) Oct.

Nickel, chromium, molybdenum, and niobium were determined in aqueous solutions of stainless steels by x-ray fluorescence spectrometry. Nickel, chromium, and molybdenum are determined directly in solution, while niobium is separated by conversion to Nb_2O_5 and determined after briquetting with cellulose powder. The method is considerably faster than conventional wet-chemical techniques and gives results which are more precise and accurate than those from previously reported x-ray methods. The standard deviation for all four elements is better than 1% of the amount present in the concentration range of interest. Agreement between chemical and x-ray fluorescence results on standard steel samples is within 1%. (auth)

184

APPLICATION OF X-RAY FLUORESCENCE METH-

ODS TO THE ANALYSIS OF ZIRCALOY. R. W. Ashley and R. W. Jones (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Anal. Chem. 31, 1632-35(1959) Oct.

X-ray fluorescence methods were investigated for the determination of tin, iron, chromium, and nickel in Zircaloy-2. In one method analyses were made on samples in the form of oxides briquetted with cellulose powder. In a second method the bulk of the zirconium in the sample was removed by extraction with thenoyltrifluoroacetone. The alloying elements were concentrated by precipitation and briquetted with cellulose powder. Both methods are precise and accurate enough to be utilized to check compliance with specifications. The direct determination of hafnium in Zircaloy has also been investigated. The sensitivity for the hafnium $L\gamma_1$ line, which is the only one relatively free from zirconium interference, is too low for determination of hafnium at concentrations below 200 ppm. Elimination of interference of the zirconium K series with the hafnium L series by pulse height discrimination is impractical for the low concentrations of hafnium involved. (auth)

185

SEALED TUBE COMBUSTIONS FOR THE DETERMINATION OF CARBON-14 AND TOTAL CARBON. Donald L. Buchanan and Betty J. Corcoran (Veterans Administration Hospital, West Haven, Conn., and Yale Univ., New Haven). Anal. Chem. 31, 1635-8(1959) Oct.

Conventional wet or dry combustions are associated with the formation of nitrogen oxides which even in minute amounts cause undesirable effects in proportional counters. Simultaneous microdeterminations of total carbon and carbon-14 may be performed by oxidation with cupric oxide in sealed Vycor tubes at 850°C. Manganese dioxide is added to provide free oxygen and cupric chloride displaces carbonate whenever basic metals are present. The carbon determination is as precise as it is in other types of oxidation used for carbon radioassay and the carbon dioxide is very pure as judged by its counting characteristics. (auth)

186

SPECTROGRAPHIC ANALYSIS OF MOLYBDENUM METAL POWDER. Rudolph Dyck and Thomas J. Veleker (Sylvania Electric Products Inc., Towanda, Penna.). Anal. Chem. 31, 1640-43(1959) Oct.

The following elements in molybdenum metal powder are determined spectrographically: aluminum, barium, calcium, chromium, copper, iron, potassium, magnesium, manganese, sodium, nickel, lead, silicon, tin, strontium, and tungsten. Samples are buffered with graphite mixtures containing the internal standard. A high-voltage alternating-current arc is used for all the elements except the alkalies and tungsten, for which direct current is used. The combined effect of graphite buffering and high-voltage alternating-current excitation produces an extremely refractory matrix during arcing, depressing molybdenum, and enhancing the medium volatility elements. Tungsten is enhanced by buffering with zinc oxide. The method is far superior to wet chemical analysis in simplicity, speed, and sensitivity. It is reasonably accurate and has been applied to the control of molybdenum purity. (auth)

187

SPECTROCHEMICAL DETERMINATION OF TRACE IMPURITIES IN PLUTONIUM NITRATE SOLUTIONS. A. J. Johnson and Edward Vejvoda (Dow Chemical Co., Denver). Anal. Chem. 31, 1643-46(1959) Oct.

A direct spectrographic method was developed for

determining trace amounts of impurities in plutonium nitrate solutions. A 25 μl volume of the solution containing 500 γ of plutonium is evaporated onto 800 γ of sodium fluoride, previously evaporated in a shallow cratered electrode. The electrode is excited by an alternating current arc and the spectrum recorded on a photographic plate. The method is applicable for the determination of 34 elements. (auth)

188

TETRAHYDROFURAN–WATER MIXTURE AS A POLAROGRAPHIC SOLVENT. DETERMINATION OF THE LOWER POLYPHENYLS. Louis Silverman, Wanda G. Bradshaw, and Mary E. Shideler (Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.). Anal. Chem. 31, 1669-71(1959) Oct.

Tetrahydrofuran-water mixture is a satisfactory medium for polarographic studies of certain organic compounds. It is particularly adaptable for routine analyses because it may be purchased in a relatively pure form and any small amounts of impurities present may be quickly and easily removed by passing it through a column of activated alumina. Tetrahydrofuran has good solvent action for supporting electrolytes such as tetrabutylammonium iodide and for many organic compounds. The diffusion currents obtained for organic compounds in this medium are higher than those obtained in dioxane-water solvent. Biphenyl and the terphenyls can be determined quantitatively using this medium and reduction waves also were obtained for p-bromo-diphenyl, nitrobenzene, naphthalene, triphenylene, 2-bromonaphthalene, anthracene, and pyrene. (auth)

189

DESIGN CONSIDERATIONS OF A GAS CHROMATOG-RAPHY SYSTEM EMPLOYING HIGH EFFICIENCY GOLAY COLUMNS. Richard D. Condon (Perkin-Elmer Corp., Norwalk, Conn.). Anal. Chem. 31, 1717-22(1959) Oct.

The application of Golay columns, using highly sensitive ionization detectors, to gas chromatography is described. Samples with a wide boiling point range, as well as those with close range boiling points, can be separated in a relatively short time with high efficiencies. Samples with low vapor pressures can also be analyzed. Low concentration analysis should also benefit from these disclosures. Gas chromatography as an anlytical tool may be extended to new areas not heretofore possible with current instrumentation. (auth)

190

INFLUENCE OF PRESSURE GRADIENTS ON RESOLUTION IN GAS CHROMATOGRAPHY. George H. Stewart, Spencer L. Seager, and J. Calvin Giddings (Univ. of Utah, Salt Lake City). Anal. Chem. 31, 1738(1959) Oct.

The height equivalent to a theoretical plate is usually assumed to be given for a gas chromatographic column as $H = A + B/pv + Cv + Dpv$, where p and v are the local values of pressure and velocity, respectively, and A, B, C, and D are molecular and column constants for a given system. The measured value of H, $\hat{H}$, is obtained by the equation $H = L(\tau/t)^2$, where L is the column length, t the retention time, and τ is the standard deviation in retention time, or one fourth the peak width. For a column without gradients $H = \hat{H}$. The presence of an inlet pressure, p_i, different from the outlet pressure, p_0, alters this equation. The correct equation, relating column performance $\hat{H}$ to the microscopic parameters, A, B, C, and D, is obtained. (auth)

191

RADIOASSAY OF AQUEOUS SAMPLES. Alicia Marcó, Jean C. Scott, J. C. Elwood, and J. T. Van Bruggen (Univ. of Oregon, Portland). Anal. Chem. 31, 1746-7(1959) Oct.

A liquid sample counting technique was developed for samples where adequate activity is available. Not less than 0.5 ml of the liquid sample is added to stainless steel cupped planchets. A thin film of Mylar is used to cover the cup. A 6% error is expected in the total counts accumulated. (C.J.G.)

192

DETERMINATION OF FREE HYDROFLUORIC ACID IN TANTALUM–NIOBIUM–HYDROFLUORIC ACID SOLUTIONS BY NEAR-INFRARED SPECTROPHOTOMETRY. W. J. Allan and A. R. Gahler (Union Carbide Corp., Niagara Falls, N. Y.). Anal. Chem. 31, 1778-83 (1959) Nov.

A method for determining free hydrofluoric acid in HF–Nb–Ta solutions is described. The solution absorbency at 1835 mμ is measured in a thin cell with sapphire windows. An anomalous effect of cell size was observed. Interferences are discussed along with other results. It is pointed out that qualitative information about the ionic species present in this system was established, and that similar techniques should be applicable to acids in other systems. (J.R.D.)

193

SPECTROPHOTOMETRIC DETERMINATION OF NIOBIUM IN TANTALUM. Karl S. Bergstresser (Los Alamos Scientific Lab., N. Mex.). Anal. Chem. 31 1812-14(1959) Nov.

An improved spectrophotometric method for 1 to 100 ppm Nb in high-purity Ta metal or oxide is presented. The method is based on a separation of the two metals by anion exchange. An average error of 0.05 γ of Nb was observed in samples which contained from 4 to 9 γ of Nb. Other metals present in quantities expected in high-purity Ta do not interfere. (J.R.D.)

194

EXTRACTION AND DETERMINATION OF THORIUM FROM SULFATE AND PHOSPHATE SOLUTIONS WITH TRI-n-OCTYLPHOSPHINE OXIDE. W. J. Ross and J. C. White (Oak Ridge National Lab., Tenn.). Anal. Chem. 31, 1847-50(1959) Nov.

A method is presented for the determination of thorium in samples resulting from the leaching of monazite sands and other raw materials with sulfuric acid, and from subsequent stages in the separation of thorium by solvent extraction processes. Tri-n-octylphosphine oxide (TOPO) dissolved in cyclohexane is used to extract thorium by diluting the sulfate and phosphate concentration with 1$\underline{M}$ nitric acid and sufficient sodium nitrate. The maximum permissible concentrations of sulfate and phosphate are 0.5 and 0.06$\underline{M}$, respectively. Thorium is determined colorimetrically after backextraction with 0.3$\underline{M}$ sulfuric acid. Cerium(III) and the other trivalent rare earths are not extracted. The method is essentially specific for thorium and requires about one fourth the time required by conventional procedures. Thorium has been determined in the concentration range from 0.01 to 5.8 mg per ml with comparable precision. (auth)

195

ZIRCONIUM ANALYSIS BY PRODUCTION CONTROL QUANTOMETER. C. L. Easterday (Mallory-Sharon Metals Corp., Ashtabula, Ohio). Anal. Chem. 31, 1867-8(1959) Nov.

A direct-reading spectrograph was used for a routine point-to-plane analysis of zirconium. The principles involved and a description of the preparation of standards are given. The results obtained are equal to, or more accurate than, those obtained by carrier-distillation methods. The same techniques, with appropriate modifications, should find application in the analysis of zirconium alloys. (auth)

196

DETERMINATION OF FLUORINE AS LITHIUM FLUORIDE. Earle R. Caley and Gerald R. Kahle (Ohio State Univ., Columbus). Anal. Chem. 31, 1880-1(1959) Nov.

Fluorine present as fluoride in aqueous solution is quantitatively precipitated by the addition of an equal volume of a 3% solution of lithium chloride in 95% ethyl alcohol. The precipitated lithium fluoride is easily filtered off and washed in a filter crucible. After drying for an hour at 110°C, it is weighed. No special apparatus is needed and accurate results are obtained. (auth)

197

A HIGH-TEMPERATURE CELL ASSEMBLY FOR SPECTROPHOTOMETRIC STUDIES OF MOLTEN FLUORIDE SALTS. J. P. Young and J. C. White (Oak Ridge National Lab., Tenn.). Anal. Chem. 31, 1892-5 (1959) Nov.

A high-temperature cell assembly is described which was designed and fabricated specifically for spectrophotometric studies of molten fluoride salts. Temperatures as high as 780°C can be maintained inside the assembly, the exterior of which is efficiently cooled by a water jacket. The assembly fits the cell-housing assembly of the Cary recording spectrophotometer Model 14-M, and is so designed that the instrument can be readily converted from normal- to high-temperature use. Two types of cells are described, crystalline magnesium oxide and a unique pendent drop arrangement in which the molten salt is confined by a platinum ring, coil, or cylinder. The primary advantage of the latter system is the virtual elimination of corrosion by the molten salt. (auth)

198

DETERMINATION OF ALUMINUM IN HIGH TEMPERATURE ALLOYS. K. L. Cheng and Francis J. Warmuth (Kelsey-Hayes Co., New Hartford, N. Y.). Chemist Analyst 48, 74-6(1959) Sept.

The determination of aluminum in complex high-temperature alloys containing many interfering alloys was performed using an EDTA titration employing PAN as an indicator after previous application of mercury cathode and cupferron separations. The results obtained were in satisfactory agreement with results obtained by the gravimetric phosphate method. (C.J.G.)

199

DETERMINATION OF THE U-235 CONTENTS OF URANIUM BY A RADIOCHEMICAL METHOD. I. G. de Fraenz and W. Seelmann-Eggebert (Comisión Nacional de Energía Atómica, Buenos Aires). Publs. com. nacl. energía atómica (Buenos Aires) Ser. quim. 1, No. 1, 1-9(1954). (In Spanish)

A fast radiochemical method is given, which permits the determination of the isotopic relation between U-235 and U-238. The method is based on two special separations of Th-231 and Th-234 from uranium, so that the relation between the activities of these thorium isotopes can be easily measured. The isotopic relation to be determined is calculated from the relation of activities of

the daughter substances. By means of a series of experiments, it is shown with what accuracy the analysis can be carried out in practice. (auth)

200

COLOR REACTIONS FOR DISTINGUISHING LANTHANUM FROM CERIUM. F. S. Frum. Trudy Khim. i Khim. Tekh., No. 1, 132-3(1958).

Lanthanum produces an orange coloring with acid monochrome bordeaux C (I). Cerium-IV and Ce^{3+} do not produce any color. Detectable minimum of La is 1.5 γ/cc, minimum concentration is 1:660,000. Aluminum, Be, Ca, Ti, Th, UC_2^{2+}, and Fe^{3+}, which also produce a yellow and orange coloring with I, impede the determination. The method is applicable for the colorimetric microtitration of La in dilute solutions of its salts. It is feasible to determine 2 to 10 γ/cc La by the standard-series method with 12.5% maximum error. In the presence of Ce^{3+} galleinphthalein produces a blue or violet color. The detectable minimum is $\frac{1}{2} \gamma/cc$ Ce^{3+}, the minimum concentration is 1:800,000 at pH 11.4. With other pH values the reaction is less sensitive. Phosphates, La(258 γ/cc), and salts of Nd and Pr impede the reaction. The reaction can be used for the quantitative determination of Ce by the standard-series method. Determination of 3 to 25 γ/cc Ce^{3+} is achieved with $\leq 10\%$ error. (TCO)

201

ON THE POTENTIOMETRIC DETERMINATION OF LANTHANUM, CERIUM, PRASEODYMIUM, NEODYMIUM, AND SAMARIUM. L. Ya. Polyak and F. M. Shemyakin. Trudy Komissii Anal. Khim. Akad. Nauk S.S.S.R., Inst. Geokhim i Anal. Khim. 7, 276-88(1956). (Translated from Referat. Zhur. Met. No. 1, 1957, p.216).

It is established that Ce and La form $MeKFe(CN)_6$-type compounds with $[Fe(CN)_6]^{4-}$ and $Me_2(C_2O_4)_3$ with $[C_2O_4]^{2-}$, which can be determined by potentiometric titration using quinhydrone, antimony, and glass electrodes paired with saturated cathode electrolyte. Elements that are precipitated by the above reagents or form complex compounds with them impede the determination. The accuracy of the determination is equivalent to that of the gravimetric method of precipitating rare earths in the form of oxalates.

202

A METHOD OF DETERMINING BERYLLIUM IN ORES BY PHOTONEUTRONS. B. S. Aydarkin, G. V. Gorshkov, A. G. Grammakov, V. S. Zhadin, and A. G. Kolchina. Trudy Radievogo Inst. im. V. G. Khlopina 7, 89-93(1957). (Translated from Referat. Zhur. Geol. No. 10, 1957, p.124).

Neutron radiation, produced by bombarding beryllium-bearing material with gamma rays of sufficient energy, was used for bombarding the target. A comparison of the radioactivity of a standard with that of a sample introduced in the target makes it possible to calculate the concentration of Be in the sample. A vial containing 48.5 mg of Ra-equivalent serves as the gamma source. Silver is used for the target. Experimental studies have shown that for a given strength of gamma radiation the introduced radioactivity, within sufficiently wide limits, is proportional to the concentration of Be. For Be concentrations of 0.1%, the error of measurement amounts to several times 10%. For concentrations of 0.5%, the error is down to 10%. For large concentrations the error is lowered in proportion to the square root of the concentration.

203

THE INFLUENCE OF DIFFERENT ELEMENTS ON
THE FLUORESCENCE OF URANIUM IN SODIUM
FLUORIDE. I. E. Starik, F. E. Starik, L. Ya.
Atrashenkok, G. B. Kostyrev, V. N. Kosyakov, and
A. Ya. Krylov. Trudy Radievogo Inst. im. V. G.
Khlopina 7, 114-25(1956). (Translated from Referat.
Zhur. Geol. No. 10, 1957, p 124).

The influence of 45 elements on the fluorescence of U
in NaF was studied. The investigations were made on
beads of NaF weighing 5 mg and containing 5×10^{-9} g of
U. The elements were introduced into the bead either
by mixing with NaF or with the corresponding salt, in
different proportions or by dipping the bead of NaF, into
the quenching salt solution. The intensity of fluores-
cence is strongly influenced by the surface of the bead,
which is a function of the quality of fusion, of the cooling
of the bead, and also of the quantity of NaF. The ele-
ments investigated may be divided approximately into
five groups, according to their influence on the fluores-
cence of uranium. (1) Na, K, Rb, Zn, Ti, S, Mo, W, Cl,
Br, and I show essentially no effect, even in relatively
large quantities. (2) Be, Ce, La, Th, P, Ni, Fe, Mn, Cu,
Sr, Cd, Mg, B, Se, Cs, Zn, Ba, Li, and Si extinguish
fluorescence when present in the bead in large quanti-
ties (on the order of several % of the weight of the
bead). (3) Ag, Hg, Pb, Bi, Cr, and Co sharply extinguish
the fluorescence when present in quantities several
times ten % of the weight of the bead. (4) Ca, Al, Tl,
and Sn strengthen the fluorescence or produce changes
in the color. (5) Ce, V, Nb, Ta, and Sb produce dis-
tinctive fluorescence in NaF.

204

INVESTIGATION OF THE ABSORPTION SPECTRA OF
THE COMBINATIONS OF SOME ELEMENTS WITH
QUERCETIN. 1. DETERMINATION OF THORIUM IN
MONAZITE-SAND. I. P. Alimarin, A. P. Golovina,
A. F. Kuteynikov, and N. F. Stepanov. Vestnik Moskov.
Univ. Ser. Mat. Mekhan. Astron. Fiz. i Khim. No. 2,
203-6(1958).

The absorption spectra of quercetin with Th, Zr, Ti,
U(VI), Ce(III), Fe(III), Ga, La, Al, Be, Cu(II), and Sn(IV)
were investigated. A photometric method with the use
of quercetin is proposed for the determination of thorium
in monazite sand. (TCO)

205

DETERMINATION OF RESIDUAL ALUMINUM AND
SMALL AMOUNTS OF BORON AND ZIRCONIUM IN
IRON AND STEEL BY MEANS OF SPECTROGRAPHIC
ANALYSIS. E. S. Prigozhina. Vsesoyuz. Mashin-
ostroitel' Beloruss. No. 4 Minsk, 155-8(1957). (Trans-
lated from Referat. Zhur. Met. No. 12, 1958, p.197).

To prepare standard specimens containing B, 100 g
of powdered electrolytic Fe is ground in a ball mill.
The Fe is mixed with a specified amount of $Na_2B_4O_7$.
The powder mixture is extruded through a ring-shaped
die at 6000 kg/cm^2 specific pressure. Standard speci-
mens containing Zr are prepared in a similar manner.
Standard specimens containing Al are prepared by the
same method, using Al_2O_3 which has been calcined at
1000°C for 3 hours. All standard specimens are checked
for homogeneity by the spectroscopic method. A gen-
erator for the activated alternating-current arc, an
ISP-22 spectrograph, and an MF-2 microphotometer
are used for the spectrographic analysis.

Radiation Chemistry

206   WAPD-CP-354(Del.)

Westinghouse Electric Corp. Atomic Power Div.,
Pittsburgh.
REPORT ON AMMONIA SYNTHESIS TEST. Yale Solo-
mon and Paul Cohen. Mar. 30, 1954. Decl. with dele-
tions Apr. 29, 1957. 9p. OTS.

It is evident that, although the qualitative aspects of
ammonia synthesis are firmly established, the quanti-
tative relationships are known only to a rough approxi-
mation. The major difficulty in determining the kinetics
of ammonia synthesis has been the slow rate of ap-
proach to equilibrium from nitrogen and ammonia. De-
composition studies, starting with ammonia, will help to
overcome this inherent difficulty. The side reactions
indicated by the analytical problems must be investi-
gated both to eliminate errors of measurement and to
establish the significance of side reaction products. To
achieve the necessary understanding of the ammonia
stability problem it will be necessary to: 1. Repeat the
synthesis test in the reactor allowing more time than
previously. 2. Perform an ammonia dissociation test
with the reactor. 3. Perform an ammonia dissociation
test on the Van de Graaff loop. (auth)

207   WAPD-CP-535(Del.)

Westinghouse Electric Corp. Atomic Power Div.,
Pittsburgh.
SECOND AMMONIA SYNTHESIS TEST—T-474893.
July 6, 1954. Decl. with deletions Mar. 18, 1957. 40p.
OTS.

A second ammonia synthesis test was run. Kinetics
for the reaction, consistent with the data of this test
and past data are proposed. These kinetics involve a
formation, first order in nitrogen, and a decomposition,
first order in ammonia. Both reactions are directly
proportional to reactor power. The effect of using non-
deaerated make-up water is evaluated. It is concluded
that, from the point of view of oxygen removal and am-
monia synthesis, non-deaerated make-up appears feasi-
ble. An evaluation of the feasibility of ammonia as a pH
control method is made, with the conclusion that it is of
sufficient interest to warrant testing at a higher ammo-
nia concentration. (auth)

208

PREPARATION OF SUSPENDED SOLIDS SAMPLES
FOR RADIOACTIVITY COUNTING. R. L. Weatherford
and T. E. Larson (Illinois State Water Survey, Urbana).
Anal. Chem. 31, 1931(1959) Nov.

A sample preparation procedure is described in
which filter paper is used as a binder for suspended
solids in water samples for radioactivity determination.
A stable adherent deposit of the suspended matter de-
velops on the surface of the cellulose acetate, which is
tightly adherent to the planchet. The counting area is
unaltered from the specific area developed during
filtration. Data are given on factors influencing back-
scatter. (J.R.D.)

209

EFFECTS OF NUCLEAR TRANSFORMATIONS ON
BROMATES. II. COMPARISON OF THE EFFECTS OF
NEUTRON CAPTURE OF ISOMERIC TRANSITION.
I. G. Campbell (Institut de Recherches Nucléaires,
Warsaw). J. chim. phys. 56, 665-70(1959) July. (In
French)

The effects of the $Br^{79}(n,\gamma)$ reaction and the $Br^{80m} \rightarrow$ Br transition on crystalline and dissolved bromates were compared. Both the reaction and the transition produce an unstable fragment, probably bromite, reducible by MeOH in some cases. The (n,γ) reaction leads to a more complete disintegration of bromate than the transition, in that in all cases at least one $Br-O$ bond was broken. The recombination of fragments in crystalline bromates was compared for the two types of transformations. (tr-auth)

210

RADIOCHEMICAL POLYMERIZATION OF METHYL METHACRYLATE IN AQUEOUS SOLUTION. Florence Fiquet-Fayard (Université, Paris). J. chim. phys. 56, 692-8(1959) July. (In French)

The polymerization of methyl methacrylate by $Co^{60} \gamma$ rays in an 0.132 mole/liter aqueous solution was done at a constant speed at up to 50% conversion. This speed is proportional to $I^{\frac{1}{2}}$. The molecular weight was measured by osmometry and G_r (H_2O) was found to be 5 ± 0.4 and $k\rho/kt^{\frac{1}{2}} = 1.08$. The quantity of monomer adsorbed on the polymer was less than 2 wt.% and 10% of the monomer is transformed at the beginning of the reaction into an unidentifiable body, volatile and saturated, perhaps a telomer. (tr-auth)

211

EFFECTS OF THE GLASS WALLS IN FERROUS SULFATE DOSIMETRY. Jean R. Puig and Jack Sutton (Centre d'Études nucléaires, Saclay, France). J. chim. phys. 56, 699-701(1959) July. (In French)

Dosimetry with ferrous sulfate in glass tubes gives intensity measurements which can be several per cent high because of the effect of the walls. (tr-auth)

212

EFFECT OF GAMMA RADIATION ON ADSORPTION OF IONS IN AQUEOUS SOLUTION. M. Haissinsky and J. Siejka (Laboratoire Curie, Paris). J. chim. phys. 56, 702-3(1959) July. (In French)

The adsorption of radioactive ions on Pt, stainless steel, and polyvinyl chloride irradiated with a 700-c Co^{60} source was studied. Strong fluctuations were found, evidencing important qualitative effects, particularly in the case of cations. The oxide film on metals plays an important part in ion fixation. (T.R.H.)

213

EQUILIBRIUM IN THE EXCHANGE OF HYDROGEN BETWEEN ARSINE AND WATER. Alfred H. Zeltmann and George Gerhold (Los Alamos Scientific Lab., N. Mex.). J. Chem. Phys. 31, 889-91(1959) Oct.

The equilibrium constant for the reaction $AsH_2D(g) + H_2O(l) \rightleftharpoons AsH_3(g) + HDO(l)$ was measured at 25.4°C and found to be 1.89 ± 0.02, corresponding to a value in the gas phase of 1.77 ± 0.02. With the known vibrational spectra of AsH_3 and AsH_3-d_3 the gas phase equilibrium constant was calculated at 25.4°, $K_2 = 0.777e^{258/T} = 1.84$. (auth)

214

ACTIVITY CONCEPT IN RADIATION CHEMISTRY. H. A. Mahlman (Oak Ridge National Lab., Tenn.). J. Chem. Phys. 31, 993-5(1959) Oct.

The decomposition of aqueous solutions by ionizing radiations has been interpreted by assuming an initial solvent decomposition into H atoms and OH radicals. Radical recombination gives rise to the observed molecular products H_2 and H_2O_2. Substantiating this hypothesis, it was demonstrated that reaction of solutes with the radicals depress the yields of the molecular products. The linear dependence of the molecular yields on the cube root of the solute molarity applies very well for dilute solutions of strong electrolytes, however, in more concentrated solutions considerable deviation is observed. It is in this region that the activity of an electrolyte manifests itself, and therefore the cube root of the activity is the criterion rather than the molarity. For this study particular attention was addressed to the depression of hydrogen yields by aqueous sodium nitrate solutions. Alteration of the molecular hydrogen yield was demonstrated by varying the scavenging solute concentration and the activity of the scavenging solute. The addition of three different salts representing uni-univalent, di-univalent, and tri-univalent electrolytes was used to alter the ionic strength of the solutions. (auth)

215

FERRIC ION YIELDS IN FERROUS SULFATE SOLUTIONS IRRADIATED WITH LOW-ENERGY X-RAYS. L. H. Gevantman and J. F. Pestaner (Naval Radiological Defense Lab., San Francisco). J. Chem. Phys. 31, 1140(1959) Oct.

A ferrous sulfate dosimeter was used to measure the absorbed doses in a study of changes induced in aqueous gel systems by low-energy x rays. The procedure used is described and results are tabulated. (J.R.D.)

216

PRIMARY PROCESSES IN THE PHOTOCHEMISTRY OF EOSIN. L. I. Grossweiner and E. F. Zwicker (Illinois Inst. of Tech., Chicago). J. Chem. Phys. 31, 1141-2 (1959) Oct.

The proposed mechanism of collisional quenching of eosin fluorescence in which the quencher molecule transfers electrons to the excited dye, thus reducing the dye through the semiquinone intermediary was supported by flash photolysis of eosin-phenol systems. Aqueous mixtures of eosin Y and Phenol were flash irradiated through a layer of ammonium citrate which limited the light absorption to the eosin visible band. The occurrence of the spectrum in the eosin-photosensitized reaction is evidence of the electron transfer. (J.R.D.)

217

NEUTRON IRRADIATION OF VARIOUS PHOSPHATES IN VACUUM. T. R. Sato, P. A. Sellers, and H. H. Strain (Argonne National Lab., Lemont, Ill.). J. Inorg. & Nuclear Chem. 11, 84-90(1959) Sept.

Neutron irradiation of phosphoric acid, of its salts, and of its linear and cyclic condensation products in vacuum produced, primarily, the corresponding radioactive compounds. Not more than traces of reduced products, such as phosphite, hypophosphite, and phosphorus, were formed. Acid phosphates gave small yields of unidentified secondary products resembling those obtained by γ irradiation. Acid phosphates did not form simple condensation products, such as pyrophosphate and tripolyphosphate, which are usually formed by heat. The irradiation products did not vary with the intensity of the neutron irradiation. From these observations, the large amount of energy liberated through neutron capture by the phosphorus atoms appears to be dissipated without disruption of the PO_4 group, without rupture of the $P-O$ or $P-O-P$ linkages, and without extensive condensation of $P-OH$ groups to $P-O-P$ linkages. (auth)

218

MASS SPECTRA OF ISOTOPIC TRIMETHYLBORANES.
W. J. Lehmann, C. O. Wilson, Jr., and I. Shapiro (Olin
Mathieson Chemical Corp., Pasadena, Calif.). J. Inorg.
& Nuclear Chem. 11, 91-103(1959) Sept.

Mass spectra of isotopically normal, B^{10}-enriched,
and deuterated trimethylboranes are analyzed. In the
isotopically normal compound an effective B^{10}/B^{11}
abundance ratio of 0.242 is calculated for the principal
range, while 0.265 and 0.259 must be used for the low
mass ranges of $B(CH_3)_3$ and $B(CD_3)_3$, respectively. Ex-
planations are offered to account for the significant dif-
ferences observed among the three monoisotopic frag-
mentation patterns. (auth)

219

HIGH ENERGY γ-IRRADIATION OF VINYL MONOMERS.
I. RADIATION POLYMERIZATION OF ACRYLONI-
TRILE. Jett C. Arthur, Jr., Robert J. Demint, and
Robert A. Pittman (Southern Regional Research Lab.,
New Orleans). J. Phys. Chem. 63, 1366-8(1959) Sept.

Acrylonitrile monomer, in the presence of water and
N,N-dimethylformamide, was exposed to high energy
γ-radiation from cobalt-60 and high dose rates ranging
from 1.21 to 5.44×10^{20} ev/l/min. Increasing radiation
dosage, ranging to 2.3×10^{24} ev/l increased the intrinsic
viscosities of the polymers rapidly and then, at higher
dosages, decreased their intrinsic viscosities exponen-
tially. After an inhibition period, which was shorter
the higher the dose rate, the rate of polymerization
of acrylonitrile monomer was proportional to the dose
rate. In contrast to polymer formation in the presence
of water, the polymers formed in N,N-dimethylforma-
mide were completely soluble in the solvent. This
may indicate that polymers formed in the presence of
water have a higher molecular weight and are more
highly crosslinked than those formed in N,N,-dimethyl-
formamide. (auth)

220

RADIOLYSIS OF METHANOL AND METHANOLIC
SOLUTIONS BY Co^{60} γ-RAYS AND 1.95×10^6 VOLT
VAN DE GRAAFF ELECTRONS. Norman N. Lichtin
(Brookhaven National Lab., Upton, N. Y.). J. Phys.
Chem. 63, 1449-54(1959) Sept.

Yields of hydrogen, formaldehyde, ethylene glycol
(determined by means of an improved procedure),
methane, and carbon monoxide per 100 ev of absorbed
radiation obtained on irradiation of methanol are
compared with values reported in the literature. The
several sets of data are not in good agreement with
each other. Initial study of the effects of several solutes
suggests a variety of modes of intervention in the
radiolytic process. (auth)

221

MELTING CHARACTERISTICS OF POLYETHYLENES.
A COMPARATIVE STUDY OF LOW-PRESSURE AND
IRRADIATED POLYETHYLENES. Leon Marker,
Robert Early, and Sundar L. Aggarwal (Olin Mathieson
Chemical Corp., New Haven). J. Polymer Sci. 38,
369-79(1959) Aug.

Dilatometers of simple design were used to determine
the relationship between specific volume and tempera-
ture for several different kinds of polyethylene: samples
with densities of approximately 0.91 and 0.96 made at
high and low pressures, respectively, and samples of
low-density material which had been irradiated with
10^6–10^8 roentgens supplied by 800-kv electrons. It was
found that polyethylene made at low pressures is not
only more crystalline than that made at high pressures,
but also that it melts much more sharply. Despite the
fact that irradiation raises the softening temperature of
polyethylene, we have shown that the melting point of the
crystalline regions of polyethylene is not thereby in-
creased. It was found that in highly irradiated poly-
ethylenes, the volume change with temperature deviates
from linearity at 150°C and rises rapidly at 170°C. (auth)

222

THE EFFECT OF THE ALKYL GROUP ON THE
IRRADIATION GRAFTING OF METHYL METHA-
CRYLATE TO POLY(ALKYL METHACRYLATES).
Roger K. Graham, Muriel S. Gluckman, and Mary J.
Kampf (Rohm and Haas Co., Bristol, Penna.). J.
Polymer Sci. 38, 417-23(1959) Aug.

Gamma irradiation of methyl methacrylate monomer
in the presence of crosslinked poly(methyl methacrylate)
leads to essentially no incorporation of new polymer
into the insoluble network. Irradiation of solutions of
poly(alkyl methacrylates) in methyl methacrylate pro-
duces graft copolymers in relatively low efficiency
when the alkyl group is butyl, lauryl, stearyl, isopropyl,
2-ethylhexyl, cyclohexyl, or neopentyl, but little graft-
ing is observed when the alkyl group is tert-butyl. It is
concluded that prediction of grafting efficiencies cannot
be made from the relative energy requirements for
polymerization of monomer and cleavage of main-chain
carbon-carbon bonds in the polymer. Evidence for
grafting of alkyl methacrylates to poly(alkyl acrylates)
is also presented.

223

RATE OF FORMATION AND DECAY OF FREE RADI-
CALS IN γ-IRRADIATED POLYMETHYL METHACRY-
LATE BY MEANS OF ELECTRON SPIN RESONANCE
ABSORPTION MEASUREMENTS. Shun-Ichi Ohnishi
and Isamu Nitta (Japanese Assn. for Radiation Re-
search on Polymers, Osaka). J. Polymer Sci. 38,
451-8(1959) Aug.

The results on the rate of formation of free radicals
in polymethyl methacrylate by gamma irradiation, the
rate of decay of the free radicals in vacuum and in the
presence of air after irradiation are presented. The
rate of decay of oxygenated free radicals by means of
electron spin resonance absorption measurements are
also reported. (J.E.D.)

224

RADIATION STABILITY OF SILICONE GREASES. D. J.
Fischer, J. F. Zack, Jr., and E. L. Warrick (Dow
Corning Corp., Midland, Mich.). Lubrication Eng. 15,
407-9(1959).

Within the class of silicone materials, a group of
radiation stable fluids exists. The stability of these
fluids can be translated to grease formulations if the
proper fluid molecular weight and filler type are used.
Siloxane fluids with higher aromatic content are shown
to be more radiation stable. Greases prepared with
these fluids and suitable fillers can be expected to be
superior high temperature radiation stable materials.
Number 710 fluid filled with copper phthalocyanine has
very little change in consistency throughout a 1300
megarep static test irradiation treatment. This stability
justifies the dynamic test measurements in progress.
(auth)

225

THERMAL DECOMPOSITION OF IRRADIATED LEAD

OXALATE. G. Porter and J. A. Smith (The University, Sheffield, Yorkshire, Eng.). Nature 184, Suppl. 7, 445-7(1959) Aug. 8.

Thermolysis of lead acetate at 300 to 325°C was studied. It was prepared by precipitation from N/600 $Na_2C_2O_4$ by slow addition of $Pb(NO_3)_2$. Doses of 70 and 250 Mrad at 4×10^6 rad/hr caused a shortening of the induction period and acceleration of the reaction. (T.R.H.)

226

CHANGE OF SOME PROPERTIES OF POLYVINYL CHLORIDE BY IONIZING RADIATION. D. Nachtigall (Gesellschaft zur Förderung der Kernphysikalischen Forschung, Jülich, Ger.). Naturwissenschaften 46, 530(1959). (In German)

Various polyvinyl chlorides were exposed to x and gamma radiation from 10^2 to 10^6 r in air. One series of samples was irradiated in vacuum. The viscosity of dissolved samples, the dielectric properties, and the breakdown voltage of the irradiated polymers were determined. (J.S.R.)

227

THE CHEMISTRY OF FISSION PRODUCTS IN A MOLTEN METAL NUCLEAR FUEL. Allen M. Eshaya and Richard H. Wiswall (Brookhaven National Lab., Upton, N. Y.). Trans. N. Y. Acad. Sci. 21, 668-81(1959) June.

Methods of removing fission products from a $U-Bi$ fuel solution are discussed. The solubility of Xe^{135} in a liquid fuel composed of uranium (600 to 1000 ppm), zirconium (100 to 300 ppm), magnesium (50 to 1000 ppm), and bismuth was determined to be 2.5×10^{-8} moles Xe/mole Bi-atm at 500°C. Tests on graphite capsules filled with U−Bi fuel and irradiated for 15 days at an average flux of 2×10^{12} neutrons/cm^2-sec indicate that both Xe^{133} and I^{131} have a strong tendency to concentrate at or near the liquid metal-graphite boundary. Similar graphite capsules of 3 concentric graphite layers of 1.5 mm thickness containing U−Bi were irradiated for 15 days and then equilibrated at 500°C for 75, 15, and 5 hours. The 75-hr equilibration resulted in a uniform distribution throughout the three layers. Significant differences in second and third layer concentrations existed at 15 hours; at 5 hours a concentration difference was noted between the first and second layers. The Xe^{131} concentration in liquid Bi was found to increase upon the addition of ThO_2 particles. The constancy of the equilibrium constants of Ce, La, Nd, Sm, U, and Zr were tested and correlated with the thermodynamic properties of $MgCl_2-NaCl-KCl$ and Mg−Bi. From this correlation the separation factor, ratio of the distribution coefficient of a fission product element to that of U, was determined. Infinite dilution values were determined for Ce, Li, Mg, Na, and U in bismuth. (C.J.G.)

Radiochemistry

228   KAPL-M-ELZ-5

Knolls Atomic Power Lab., Schenectady, N. Y. DECONTAMINATION OF IRRADIATED U-235 SAMPLES FOR ISOTOPIC ANALYSIS. J. W. Codding, B. L. Vondra, and E. L. Zebroski. May 19, 1952. Decl. Oct. 15, 1959. 13p. Contract W-31-109-Eng-52. OTS.

A simple procedure for manual extraction and decontamination of U samples, with large decontamination factors, from fission products and Pu was developed for

mass spectrographic isotopic analysis. If high recoveries are required, countercurrent flow extraction may be used in miniature mixer-settler equipment. (F.S.)

229

THE CHEMISTRY OF THE ARTIFICIAL RADIOELEMENTS. C. Fisher (Commissariat à l'Énergie Atomique, Paris). Inds. atomiques 3, No. 7-8, 49-54 (1959) (In French)

The chemistry of artificial radioelements is discussed. Target preparation and treatment after irradiation is described. Techniques for labeling molecules are summarized, and the part played by fission products is pointed out. The chemical, radioactive, and radiochemical purity is also discussed. (T.R.H.)

230

DETERMINATION OF SOLUBILITY PRODUCTS BY RADIOMETRIC TITRATION-A NEW METHOD. J. F. Duncan (Univ. of Melbourne, Carlton, Australia). J. Inorg. & Nuclear Chem. 11, 161-3(1959) Sept.

To a solution containing one ion at a known concentration is added a known volume of a solution containing a known concentration of the second ion. Agitation of the mixture and time allowance for complete equilibration of the saturated solution and precipitated solid is then performed. After equilibration the solid is allowed to settle or is centrifuged. Serious error at this stage can be avoided by forming the precipitate under conditions in which rapid coagulation is obtained (solutions in concentration range 0.01 to 2 $\underline{M}$). After removal of the solid, the activity of 5 ml of the supernatant liquid is compared with that of 5 ml of the original solution of concentration $[N^-]_0$. The solubility product for lead iodide was determined by the above titration method to be $0.88 \pm 0.20 \times 10^{-8}$ at 18° in agreement with other experimental values. (C.J.G.)

231

SELF-ABSORPTION CORRECTION FOR CARBON-14. A NEW TREATMENT YIELDS A CORRECTION FACTOR THAT IS LINEARLY RELATED TO THE THICKNESS OF THE SAMPLE. Richard W. Hendler (National Institutes of Health, Bethesda, Md.). Science 130, 772-7(1959) Sept. 25.

A new and simple technique was developed for correcting C^{14} radioactivity measurements for loss of radiation due to self absorption. Results are discussed which show the applicability of the technique for many different counting situations. It is found that the absorption of radiation follows a hyperbolic law much more closely than an exponential one. Futhermore, the absorption coefficient for the sample itself was found to be a function of weight rather than a constant, as had been assumed for the derivation of the law of exponential absorption. (auth)

Raw Materials and Feed Materials

232   JEN-57

Spain. Junta de Energia Nuclear, Madrid. ESTUDIO DE LA EXTRACCIÓN DE COBRE EN MINERAL DE LA MINA "LA VIRGEN" DE SANTA MARÍA DE LA CABEZA (JAÉN). (Study of Copper Extraction in Minerals from "La Virgen," Santa María de la Cabeza (Jaen)). T. Batuecas Rodriguez, H. Sanz Garcia, M. Urgell Comas, J. A. Perez Bustamante, A. Sevilla Benito, F. De La Cruz Castillo, and R. Fernandez Cellini. 1959. 19p.

The conditions for the acid leaching of copper from minerals of the La Virgen mine are studied. From the results obtained, a preliminary roasting of the minerals and then leaching with 5% sulfuric acid while the minerals are still hot give the best yield. The use of acids other than sulfuric acid as leaching agents does not affect materially the copper yield. The addition of ferric sulfate as an oxidizing agent is equivalent to a preliminary roasting. Possible chemical and electrochemical procedures for the recovery of copper from the leach solutions are discussed. (tr-auth)

233   NP-7950

Eldorado Mining and Refining Ltd. Research and Development Div., Ottawa.

RESEARCH AND DEVELOPMENT REPORT FOR SEPTEMBER 1959. 40p. (R59-9).

New Process Development. Chlorination tests were run on ground Beaverlodge ore to check reproducibility of results. In the solvent-in-pulp program reproducibility tests were conducted on Pronto leach slurry which was desanded in a pilot plant hydrocyclone. Process Development. Laboratory data were obtained showing the effect of HNO_3 strength and operating temperatures on copper cathode corrosion. Plant operating conditions were recommended for leaching of off-specification green salt with sodium chlorate-ferric iron solution. Several graphite crucibles were destroyed in the violence of the reaction in recent metal production tests using the British-type reactor. Grain size and inclusion data are reported on the first eight samples of forged metal for the pencil-rod program. Three analytical methods were developed for the determination of solvent molarities in kerosene. (For preceding period see NP-7961.) (W.L.H.)

234   NP-7951

Eldorado Mining and Refining Ltd. Research and Development Div., Ottawa.

RESEARCH AND DEVELOPMENT REPORT FOR JANUARY 1959. 51p. (R59-1).

In the solvent-in-pulp program, an alcohol additive was found to decrease the amount of solids lost to the crud. Solvent extraction tests on synthetic Blind River pregnant liquor indicated poor extraction at pH values of 0.5 and lower. In amalgam reduction tests on synthetic Blind River eluates, good barrens were obtained and UO_2 formulations were in the range of $UO_{2.03}$ to $UO_{2.07}$. Studies on the thermal decomposition of uranous sulfate have shown that a temperature of 910°C is required to transform samples into U_3O_8. In standard carbonate leach tests, U_3O_8 extractions of 88.6 and 90.0% were obtained with synthetic and November mill solutions, respectively. Carbonate leaching results on a Verna refractory ore sample were still unsatisfactory at twice the usual leaching retention time. Carbonate leaching tests using $Cu-NH_3$ catalysts did not result in significantly lower U_3O_8 tails. Five metal production runs were made in the British type laboratory reaction vessel. A dry run was carried out on the vertical reactor for UO_2 production tests. Increased retention time was required in HNO_3 acid leaching tests on coarse slag, 15%−200 mesh. (For preceding period see NP-7957.) (W.L.H.)

235   NP-7952

Eldorado Mining and Refining Ltd. Research and Development Div., Ottawa.

RESEARCH AND DEVELOPMENT REPORT FOR JUNE 1959. 47p. (R59-6).

New Process Development. Various reagents were tested for removal of U from Beaverlodge carbonate pregnant solution prior to amalgam reduction. Uranous sulfate crystals were produced by precipitation from electrolytically reduced synthetic H_2SO_4 eluates. In the solvent-in-pulp program, a U extraction of 84% was obtained in a batch equilibrium counter-current test with two minutes mixing time and mild agitation. In tests on the direct chlorination of cobbed Port Radium ore, 40 minutes retention was required at 600°C for 99% U volatilization whereas 99.9% volatilization was obtained in 20 minutes at 700°C. Process Development. Uranium extraction of 91.3% was obtained in standard carbonate leaching of Beaverlodge ore. Metal production tests were continued in a study of the effect of charge density and particle size on the reaction. Sintered densities were low on UO_2 compacts prepared from powders produced in the vertical plate-type reactor. Turbidimetric methods were developed for the determination of sulfate traces in samples containing U and for the determination of solids in spiractor overflow. (For preceding period see NP-7953.) (W.L.H.)

236   NP-7953

Eldorado Mining and Refining Ltd. Research and Development Div., Ottawa.

RESEARCH AND DEVELOPMENT REPORT FOR MAY 1959. 43p. (R59-5).

New Process Development. In the solvent-in-pulp program, good recovery of amine from contacted pulp was obtained by flotation, but solids carry-over in the froth was very high. A series of tests was commended on the use of additives to reduce V and Si levels in Beaverlodge carbonate pregnant solution prior to amalgam reduction. Pronto pregnant solution was used as fuel in all work on purification by liquid ion exchange. In preliminary tests on the study of direct chlorination of ores, samples of U_3O_8 were volatilized completely by chlorination. Process Development. Lapointe picker belt tests on Verna refractory ore resulted in a recovery of 88.2% of the U in 62.9% of the ore. Continuous HNO_3 leaching of slag on a laboratory scale resulted in tailings averaging 0.15 to 0.16% U. Higher fuel rates were used in tests on the reduction of ADU to UO_2 in the tray type vertical reactor. Data were obtained on the leaching of various Port Hope recycle materials with sodium chlorate-ferric iron solutions. A colorimetric method was developed for the determination of the specific surface area of Mg metal granules. (For preceding period see NP-7958.) (W.L.H.)

237   NP-7954

Eldorado Mining and Refining Ltd. Research and Development Div., Ottawa.

RESEARCH AND DEVELOPMENT REPORT FOR MARCH 1959. 46p. (R59-3).

New Process Development. Solvent extraction of a slurry prepared by acid leaching of a Port Radium ore resulted in raffinate U_3O_8 levels of 0.005 to 0.009 g/liter. In the amalgam reduction program pyrophoric UO_2 was obtained from the cool section of the drying furnace. Differential thermal analysis was completed on series of UO_2 samples from the amalgam reduction process. Spectrographic assays were obtained on UO_2 samples prepared from Algom liquors by a procedure involving amine extraction and ammonium carbonate re-extraction. Process Development. In acid leaching tests on refractory Verna ore, 90% U extraction was obtained at 40°C. Data are reported on sixty-three froth flotation tests on Beaverlodge refractory ore. Three

metal-production runs were carried out using a new 4 in. ID stainless steel British-type reactor. Ceramic UO_2 was produced from Port Hope ADU on a small scale by a continuous process using a vertical plate-type reactor. New plant-scale refinery equipment for solvent treatment by adsorption was tested and found effective in reducing solvent emulsification tendencies. A colorimetric method was developed for the determination of the surface area of Mg metal granules. (For preceding period see NP-7955.) (W.L.H.)

238 NP-7955
Eldorado Mining and Refining Ltd. Research and Development Div., Ottawa.
RESEARCH AND DEVELOPMENT REPORT FOR FEBRUARY 1959. 50p. (R59-2).

A new series of tests was commenced in the solvent-in-pulp program with the emphasis to be on U extraction and amine loss data. Electrolytic reduction of $(NH_4)_2SO_4$ strip solution resulted in precipitation of a basic $U(SO_4)_2$ at pH values between 1.9 and 2.5. Uranyl sulfate required heating to 820°C for decomposition to U_3O_8. In laboratory tests on coarse spiractor calcium carbonate product the Na content was reduced to ~one percent with a one-displacement water wash. The effect of temperature, $NaClO_3$ level, and grind were investigated in acid leaching of refractory Beaverlodge ore. Flotation testing on refractory ore using a fatty acid collector resulted in a U_3O_8 recovery of 67% in 42% of the weight. Six firings were carried out in the British-type metal production reactor. Tests indicated the solubility of MgF_2 in HNO_3 to be low under the conditions required for extraction of U from slag. Nitric acid leaching tests were carried out on various slags. Tests were commenced on the use of differential thermal analysis to predict sinterability of UO_2 samples. (For preceding period see NP-7951.) (W.L.H.)

239 NP-7956
Eldorado Mining and Refining Ltd. Research and Development Div., Ottawa.
RESEARCH AND DEVELOPMENT REPORT FOR NOVEMBER 1958. 53p. (R58-11).

Amalgam reduction tests on sodium sulfate strip solutions have given products which appear to contain uranous sulfate. Testwork on continuous sodium sulfate stripping has given NaOH consumptions in the order of 1.3 lbs/lb U_3O_8 and 0.3 lbs/lb U_3O_8 in stripping and precipitation, respectively. Thermal reduction of uranous sulfate resulted in UO_2 products varying from one stable in air to a pyrophoric UO_2. The amalgam reduction technique was successful in preliminary tests in scavenging U from Beaverlodge carbonate barren solution. Drying of spiractor $CaCO_3$ precipitate in a spouted-bed drier was tested. Carbonate leaching tests were continued on refractory ore samples from Beaverlodge. Gold and Cu cathodes were compared for use at the refinery in the electrolytic oxidation of chloride. Effects of Mg excess and firing pressure are being investigated in laboratory metal production tests in a British-type reactor. In HNO_3 leaching tests on slag residues ranging from <0.02 to 0.09% were obtained. Steam pyrohydrolysis of high U slag fractions has resulted in residues containing less than 0.2% F. A method was developed for the determination of small amounts of selenium in various Beaverlodge materials. (For preceding period see NP-7960.) (W.L.H.)

240 NP-7957
Eldorado Mining and Refining Ltd. Research and Development Div., Ottawa.

RESEARCH AND DEVELOPMENT REPORT FOR DECEMBER 1958. 51p. (R58-12).

In the amalgam reduction program, tests were done on the effect of drying temperature and atmosphere on purity and sinterability of reduction products. Data were obtained on chloride, chlorate, and sulfate ion transfer by electrodialysis in an Excer cell as might occur in electrolytic production of UO_2. In the solvent-in-pulp program, it was shown that desanding decreases the proportion of total leached solids lost to the creed. Emulsion and precipitation difficulties were encountered in ammonium carbonate batch stripping tests on trifatty amine extracts. Standard carbonate leach tests on mill solutions gave a U_3O_8 extraction of 88.2%. Heat pretreatment of refractory Beaverlodge ore samples was ineffective in rendering the ores amenable to carbonate leaching. Metal production tests were continued using the British-type reaction vessel. In a series of HNO_3 leaching tests on slag, all with one hour retention time, washed residues ranged from 0.13 to 0.23% U. Tests on steam pyrohydrolysis of slag fractions indicated that a retention time of 5 to 6 hours, with a temperature of at least 850°C, is required to reduce the F content from 15% F to less than 0.2% F. (For preceding period see NP-7956.) (W.L.H.)

241 NP-7958
Eldorado Mining and Refining Ltd. Research and Development Div., Ottawa.
RESEARCH AND DEVELOPMENT REPORT FOR APRIL 1959. 65p. (R59-4).

New Process Development. Extraction data from solvent-in-pulp tests showed a sharp initial increase in U extraction with increased agitation. In the amalgam reduction program two-stage drying did not result in higher surface areas unless the products were pulverized between stages. Electrolytic reduction of synthetic H_2SO_4 strip solutions gave large decontamination factors for Co, Mn, and Mo. Improved product purity was obtained in liquid ion exchange tests by better control of U loading in UO_2SO_4 scrubbing. Process Development. Calcination efficiencies of over 95% were obtained in pilot-scale tests on Beaverlodge spiractor products. Different types of green salt were compared in five metal production tests in the British-type reactor. Over 50 runs were made on the Allis-Chalmers type reactor for conversion of ADU to UO_2. Preliminary tests on a vertical packed column for conversion of ADU to UO_2 indicated that a stable product can be produced at 700°C. Several reagents were investigated as alternatives to potassium hydroxide for the hydrolysis of off-specification green salt. (For preceding period see NP-7954.) (W.L.H.)

242 NP-7959
Eldorado Mining and Refining Ltd. Research and Development Div., Ottawa.
RESEARCH AND DEVELOPMENT REPORT FOR JULY 1959. 39p. (R59-7).

New Process Development. In the solvent-in-pulp program data were obtained on the effect of mixing speed and retention time on amine losses. The addition of the disodium salt of EDTA to Beaverlodge carbonate pregnant solution resulted in a decrease of 40% in the V content of an amalgam reduction product. Hydrolysis of uranous sulfate with ammonia removed most of the sulfate. In chlorination tests on Beaverlodge ore, 90% of the U in the ore was volatilized at 500°C with a retention time of 5 hours. Process Development. A series of spiractor tests was carried out on the Beaverlodge lime

treatment process to investigate five different factors. Efforts to improve reproducibility in pressing and sintering results on UO_2 samples are continuing. Autoclave testing of UO_2 samples for corrosion resistance was commenced. Preliminary tests indicate that Al_2O_3 may be a suitable reagent for removal of fluoride from refinery HNO_3. (For preceding period see NP-7952.) (W.L.H.)

243   NP-7960
Eldorado Mining and Refining Ltd. Research and Development Div., Ottawa.
RESEARCH AND DEVELOPMENT REPORT FOR OCTOBER 1958. 45p. (R58-10).

An amalgam reduction process is under consideration for the production of ceramic grade UO_2 from a mill solution. A test program on solvent extraction from acid leach pulps is being pursued with the hope of achieving partial or complete elimination of costly ore pump filtration. Tests were performed on the scavenging of U from carbonate barren solutions with an ion exchange method using Dowex 21K. Standard carbonate leaching tests were carried out on a Beaverlodge mill feed sample to compare two mill solution samples with a synthetic solution. A vertical shaft kiln was designed and built to determine the amenability of $CaCO_3$ pellets to calcination in this type of furnace. Granular spiractor $CaCO_3$ precipitate sludge from Beaverlodge was calcined directly in a 12-in. × 12-ft gas-fired rotary kiln. A series of H_2SO_4-$NaCO_3$ leach tests was carried out on three samples of Verna and one sample of Fay which were not amenable to the atmospheric carbonate leach process. Several approaches were followed in efforts to develop a means of reducing the high chloride and chlorate levels in the Port Radium chemical precipitate. Chemical and physical data are being obtained on liner, green salt, magnesium, and slag samples from Port Hope dingot firings. A program of small-scale green salt reduction tests is in progress to determine means of improving reaction yield and control in U dingot production. A sensitive colorimetric method was developed for the determination of Mg in U metal. (W.L.H.)

244   NP-7961
Eldorado Minining and Refining Ltd. Research and Development Div., Ottawa.
RESEARCH AND DEVELOPMENT REPORT FOR AUGUST 1959. 47p. (R59-8).

New Process Development. Initial tests on a hydrogen reduction-nitrogen soaking process for wet cake from amalgam reduction have indicated that a stable non-pyrophoric product can be obtained in this way. Initial results have indicated there is a possibility of efficient strip reagent recovery in an ammonium chloride amine stripping system. Data are reported on chlorination of Beaverlodge ore at 400 and 600°C. Tests were conducted in the solvent-in-pulp program to determine the reproducibility of extraction and amine loss data. Process Development. The addition of Cu-NH_3 complex in atmospheric carbonate leach tests gave marked increases in extraction rate up to 24 hours retention time. Tests are in progress on the production of ceramic UO_2 in a packed-column type of reactor using UO_3 or U_3O_8, produced from ADU, as fuel material. Corrosion by high-chloride H_3PO_4 was found to be the source of hydrogen which caused the recent explosion in the refinery H_3PO_4 tanks. A summary of results is given on leaching of green salt with a sodium chlorate-ferric iron solution. Analytical methods were

developed for the determination of traces of Al in UO_2 samples and of Ca in Beaverlodge pregnant solution. Analytical methods were developed for the determination of traces of Al in UO_2 samples and of Ca in Beaverlodge pregnant solution. (For preceding period see NP-7959.) (W.L.H.)

245   TID-5303
Catalytic Construction Co., Fernald, Ohio.
INTEGRATED PROCESS DESIGN REPORT ON FEED MATERIALS PRODUCTION CENTER, FERNALD, OHIO; REFINERY AND GREEN SALT PLANT. Oct. 20, 1952. Decl. Oct. 7, 1959. 296p. Contract AT(30-1)-1060. OTS.

A coordinated record of the design of a FMPC processing plant for the production of pure massive U from U-containing raw materials is presented. A thorough understanding of FMPC operations may be obtained through the medium of over-all flow diagrams and associated rate criteria. (auth)

246
BLENDING VS. REENRICHMENT FOR SLIGHTLY ENRICHED URANIUM. Donald Kallman and John E. Brennan (Babcock and Wilcox Co., New York). Chem. Eng. Progr. 55, Symposium Ser. No. 23, 31-4(1959).

Blending with highly enriched uranium may permanently be practiced in place of reenrichment at the diffusion plant because the difference in cost may be small and the flexibility greater. The economics of both methods are compared relative to first-core loading and fuel-cycle costs. (auth)

247
THE RADIOMETRIC ANALYSIS OF NATURALLY LEACHED URANIUM-THORIUM ORE SAMPLES: COMPARISON OF DIFFERENT METHODS. P. W. De Lange (Council for Scientific and Industrial Research, Pretoria). J. S. African Inst. Mining and Met. 60, 640-56(1959) July.

The application of a new radiometric method for the analysis of uranium-thorium ores is discussed. This method, referred to as the $\beta-\gamma-\gamma$-method, does not rely on the fortuitous equality of some apparatus constants, but is a combination of the beta-gamma ($\beta-\gamma$) method and the γ-discrimination method ($\gamma-\gamma$) to obtain per cent U_3O_8, per cent ThO_2, and the equilibrium value of the uranium series. The minimum concentrations that can be determined are 0.005% U_3O_8 and 0.005% ThO_2 in mixed naturally leached ore using 90 gram samples. Results obtained with the $\beta-\gamma-\gamma$, $\beta-\gamma$, and $\gamma-\gamma$ methods are compared. The influence of different standards on the results is discussed. (auth)

Separation Processes

248   AERE-M-451
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
SEPARATION OF FISSION PRODUCT CAESIUM BY ZIRCONIUM PHOSPHATE. T. V Healy and B. L. Davies. July 1959. 7p. BIS.

Cesium is very weakly adsorbed on zirconium phosphate resin from acid solutions down to $0.5\underline{N}$ HNO_3 but is strongly adsorbed from $0.1\underline{N}$ HNO_3 solution. The direct adsorption on this resin of cesium from fission product concentrates even at low acidities is very weak owing to interference effects from the constituents of

the fission product concentrates, particularly aluminum and iron. (auth)

249   BMI-RI-5523
Bureau of Mines.
SEPARATION OF RARE-EARTH ELEMENTS IN BASTNASITE BY ION EXCHANGE. R. E. Lindstrom. Oct. 1958. 19p.

A study of ion-exchange resin crosslinkage and eluant flow rate, resin-bed shape, and addition of separating ions to feed stock was undertaken to determine their effect on the separation efficiency of ion-exchange on bastnasite-rare-earth elements. Results show that 12% divinylbenzene (DVB) crosslinkage resin is detrimental to separation efficiency at flow rates over 2 to 5 ml/min/cm^2, whereas, separation with 4% DVB crosslinkage resin is relatively unaffected by flow rates between 2 and 10 ml/min/cm^2. Altering the resin-bed shape has the effect of increasing separation efficiency as the length-to-diameter ratio of the resin bed is increased from 10 to 135. Addition of base-metal ions to feed stock is an effective means of attaining sharp separations between samarium and neodymium, and cerium and lanthanum. (auth)

250   CEA-913
France. Commissariat à l'Énergie Atomique, Paris.
CONTRIBUTION À L'ÉTUDE DE LA SÉPARATION DES TERRES RARES PAR ÉCHANGE D'IONS À L'AIDE DE LACTATE D'AMMONIUM. (Contribution to the Study of Rare Earth Separation by Ion Exchange Using Ammonium Lactate). I. Gratot. 1958. 19p.

Using chromatography on a column of Dowex 50 resin heated to 87°C, the separation of rare earths (from holmium to praseodymium) which may be produced with the cyclotron by heavy ions, α or protons was studied. From an ammonium lactate solution M at pH5, separations are carried out by varying the dilution as a function of the quantity of the target rare earth and of its position during elution. When weighable quantities of the rare earth (more than 5 mg) appear towards the end of the elution, the separation is little affected — this case approaches that of a tracer mixture of rare earths; if on the other hand weighable quantities of the rare earth are washed through at the beginning of the chromatogram, the dilution must be adjusted in order to obtain a good separation. (auth)

251   CF-59-7-68
Oak Ridge National Lab., Tenn.
CHEMICAL TECHNOLOGY DIVISION, CHEMICAL DEVELOPMENT, SECTION C, MONTHLY PROGRESS REPORT, JULY 1959. K. B. Brown, K. A. Allen, C. A. Blake, C. F. Coleman, D. J. Crouse, A. D. Ryon, and B. Weaver. Aug. 5, 1959. 32p. Contract [W-7405-eng-26]. OTS.

The effect of nitrate on Th extraction by primary amines was studied. Selectivity of the primary amines can be greatly improved by adding alcohol to the kerosene diluent. The flow capacity of settlers for NaCl stripping in the Amex Process was determined in a 6-in. settler for alcohol-modified and unmodified 0.1 M Rohm and Haas LA-1 amine in kerosene A process scheme is proposed for the recovery of U and Pu from H$_2$SO$_4$ stainless steel decladding solutions, by extracting U^{4+} and Pu^{3+} or Pu^{4+} with successive streams of 0.1 to 0.3 $\underline{M}$ primary amine and stripping the combined extracts with dilute HNO$_3$. The structural effects on Th and U extraction with neutral organophosphorus reagents were studied. A flowsheet was developed for the

separation of promethium from mixed fission-product rare earths by continuous multistage countercurrent extraction between TBP and HNO$_3$. The kinetic behavior of amine extractants was studied. (W.L.H.)

252   CF-59-8-45
Oak Ridge National Lab., Tenn.
CHEMICAL TECHNOLOGY DIVISION, CHEMICAL DEVELOPMENT, SECTION C, MONTHLY PROGRESS REPORT, AUGUST 1959. K. B. Brown, K. A. Allen, C. F. Coleman, D. J. Crouse, and A. D. Ryon. Sept. 8, 1959. 37p. Contract [W-7405-eng-26]. OTS.

The solvent extraction of U from carbonate solutions was studied. The prevention of silica stabilized emulsions in the Amex and Dapex processes by solvent-continuous mixing is reported. The recovery of U and Pu from H$_2$SO$_4$ decladding solutions by continuous countercurrent extraction with primary amines, HNO$_3$ stripping from primary amine, U^{6+} extraction by primary amine, and U extraction by dialkylphosphoric acid is being studied. Plutonium was effectively freed from Am contamination by extraction from 2 $\underline{M}$ HNO$_3$ with 0.1 $\underline{M}$ di(2-ethylhexyl)phosphoric acid. (For preceding period see CF-59-7-68). (W.L.H.)

253   CF-59-10-61
Oak Ridge National Lab., Tenn.
EUROCHEMIC ASSISTANCE PROGRAM: STATUS REPORT FOR APRIL THROUGH SEPTEMBER 1959. E. L. Nicholson and E. M. Shank. Oct. 19, 1959. 7p. OTS.

The status of the Eurochemic Organization and the preliminary plant design are summarized. The Eurochemic charter was ratified by all participating countries except Italy and Sweden. A revised proposal, (Project III) incorporating safe processing for up to 5% enriched uranium at 350 kg of uranium per day was cost-estimated at about 19×10^6; this proposal is expected to be accepted. The preliminary report for Projects I and II were completed and sent to the United States for review preparatory to a scheduled October visit by Eurochemic technical personnel. Several research and development programs will be started during the next several months. St. Gobain of France will probably be selected as the principal architect-engineer for the main processing plant. (auth)

254   DP-333
Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.
CONTINUOUS SOLVENT WASHING—HYDRAULIC OPERATING CHARACTERISTICS OF A LARGE-SCALE CONTINUOUS SOLVENT WASHER. Albert A. Kishbaugh. Apr. 1959. 17p. Contract AT(07-2)-1. OTS.

A large-scale continuous washer for Purex solvent was constructed from a design based upon tests on a laboratory-scale unit. The hydraulic operating characteristics and entrainment data were in reasonable agreement with the predicted performance. (auth)

255   DP-388
Du Pont de Nemours (E. I.) & Co., Savannah River Lab., Aiken, S. C.
ELECTRODEPOSITION OF PLUTONIUM AT A MERCURY CATHODE. John A. Porter. June 1959. 14p. Contract AT(07-2)-1. OTS.

Plutonium was electrodeposited at a mercury cathode from an ethanol solution of plutonium trichloride. The electrodeposition process was studied, using cerium(III) as a stand-in for plutonium(III). (auth)

256 HW-61145(Del.)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

RECOVERY OF PLUTONIUM AND NEPTUNIUM FROM PUREX IWW BY ANION EXCHANGE. H. H. Van Tuyl. July 16, 1959. Decl. with deletions Sept. 22, 1959. 6p. OTS.

The original purpose for installing the IWW anion exchange equipment in the Purex plant was to recover plutonium from high waste loss batches of IWW. The present work shows that this is feasible, and similar recovery of neptunium can also be obtained. The process can be applied to routine recovery of plutonium and neptunium from IWW even with only normal operating losses to the IWW, e.g., to reduce the neptunium losses currently experienced during reflux type operation. However, both technical and economic considerations would seem to indicate that recovery from batches with high plutonium or neptunium content would be more satisfactory. One attractive application is to recycle neptunium via the 3WB until a large inventory is developed, and then drop this to the IWW for anion exchange recovery. This has the distinct advantage of not requiring a plant shut-down for neptunium recovery. (auth)

257 IDO-14483

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

EFFECT OF DISSOLVED STAINLESS STEEL COMPONENTS ON VAPOR-LIQUID EQUILIBRIA IN AQUA-REGIA. Bernice E. Paige. July 1, 1959. 20p. Contract AT(10-1)-205. OTS.

Vapor-liquid equilibrium values were determined for chloride and nitric acid in nitric acid-hydrochloric acid-ferric nitrate-water systems. It was found that chloride vapor-liquid equilibrium values increased with increasing hydrogen ion concentration, but were more than an order of magnitude lower in the presence of $1\underline{M}$ ferric ion for solutions of greater than $6\underline{M}$ total acid. Nitric acid vapor-liquid equilibrium values increased with increasing hydrogen ion and were further increased by the addition of ferric nitrate. A study was also made of the decomposition gases which escaped from the equilibrium still during the first $1\frac{1}{2}$ hour period of operation. (auth)

258 ORNL-2714

Oak Ridge National Lab., Tenn.

LABORATORY DEVELOPMENT OF THE SULFEX PROCESS FOR THE DISSOLUTION OF CONSOLIDATED EDISON POWER REACTOR FUEL. L. M. Ferris and A. H. Kibbey. Nov. 2, 1959. 25p. Contract W-7405-eng-26. OTS.

Flowsheets given for dissolution of Consolidated Edison power reactor fuel, 96% ThO_2–4% UO_2 sintered pellets clad in type 304L stainless steel, include removal of the stainless steel cladding with a 200% stoichiometric excess of boiling 4 or 6 $\underline{M}$ H_2SO_4. The ThO_2–UO_2 core is then dissolved in boiling 13 $\underline{M}$ HNO_3–0.04 $\underline{M}$ NaF–0.04 $\underline{M}$ $Al(NO_3)_3$. Essentially complete dissolution of the stainless steel requires about 6 hr in the preferred reagent, 6 $\underline{M}$ H_2SO_4; only about 80% is dissolved in 6 hr with 4 $\underline{M}$ H_2SO_4. Uranium and thorium losses to the decladding solution were, in general, less than 0.2 and 0.1%, respectively. After decladding, about 93% of the core is dissolved in 6 to 7 hr when a 200% stoichiometric excess of dissolvent is used; the resulting solution is 1 $\underline{M}$ in thorium. The

ThO_2–UO_2 heel can be dissolved immediately in about 3 hr in fresh dissolver solution, or can remain through subsequent decladding steps. Aluminum nitrate added to the core dissolver solution to inhibit corrosion does not affect the pellet dissolution rate at concentrations below 0.1 $\underline{M}$. The solubilities of the neutron poisons boron and cadmium in process solutions were determined. Boric acid solubility was 0.2 to 0.4 $\underline{M}$ in most solutions; that of cadmium was 0.2 to 1.2 $\underline{M}$. (auth)

259 Y-1257

Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.

THE RECOVERY OF URANIUM FROM REDUCTION RESIDUES BY SEMICONTINUOUS ION EXCHANGE. N. J. Setter, J. M. Googin, and G. B. Marrow. July 9, 1959. 22p. Contract W-7405-eng-26. OTS.

Laboratory and plant data related to the recovery of uranium from magnesium fluoride slag are presented. The operation of the Higgins semicontinuous ion exchange contactor and the chemical and mechanical characteristics of the process are described. The system has proven satisfactory for processing tonnage quantities of slag waste materials. (auth)

260

THE DEVELOPMENT OF PLUTONIUM SEPARATION PROCESSES. F. R. Paulsen.: Chem. & Process Eng. 40, 271-3(1959) Aug.

The basic separation processes for plutonium, precipitation methods, solvent extraction, and dry techniques, are discussed. (C.J.G.)

261

INVESTIGATION OF THE SEPARATION PROCESSES OF URANIUM AND THORIUM ON ALGINIC ACID. I. A. Kuzin and V. P. Taushkanov. Izvest. Vysshikh Ucheb. Zavedenii Khim. i Khim. Tekhnol., No. 2, 70-4(1958).

The separation of uranium and thorium was investigated with a weakly acid cationite, alginic acid, and a highly acid "wofatite" KS. A survey of publications indicates that alginic acid represents a mixture of polycarboxylic acids of different degrees of polymerization; it may be used as sorbent for the separation of polyvalent cations from cations of lower valence. The production of alginic acid and the determination of uranium and thorium are described. The sorptive power of alginic acid and of "wofatite" KS are discussed at different pH values. The dependence of the sorptive power of these two substances on the pH value of a solution of the same concentration (per cent by weight) with regard to the ions UO_2^{2+}, Th^{4+}, and Na^+ is shown. The sorption of sodium ions by alginic acid stops at pH 1.8 to 2.0 and of uranyl ions at pH 0.5; at the same time a considerable sorptive power is maintained for thorium ions. Under the same conditions "wofatite" KS remains capable of sorbing all cations. At a pH below 2 thorium is adsorbed by alginic acid and "wofatite" KS; at higher values uranium is adsorbed. Thorium adheres better to either of the sorbents than uranium. The apparatus for separating uranium and thorium on every sorbent and its operation are described. (TCO)

262

SEPARATION OF THE LANTHANOUS AT AMALGAM CATHODES. III. ELECTROCHEMICAL FRACTIONATION OF THE LANTHANONS AT A LITHIUM AMALGAM CATHODE. E. I. Onstott (Los Alamos Scientific Lab., N. Mex.). J. Am. Chem. Soc. 81, 4451-8(1959) Sept. 5.

Electrolyses of a monazite mixture, an yttrium—earth mixture and a terbium—dysprosium mixture at a lithium—amalgam cathode were studied. The separations obtained show that individual lanthanons are electrolyzed at different rates at a lithium—amalgam cathode. The relative ease of electrolysis is; europium, ytterbium, samarium, lanthanum, and other lanthanons in the order of atomic number. Yttrium falls between erbium and thulium. Data were not obtained for lutetium. All of the lighter lanthanons through terbium can be relatively rapidly electrolyzed from aqueous lithium citrate electrolytes, but the rates of electrolysis of the heavier lanthanons except for ytterbium are quite slow from this electrolyte. Rates of electrolysis of the heavier elements are improved considerably by using a methanol electrolyte containing lithium acetate. It appears that europium and ytterbium, and possibly samarium, are rapidly electrolyzed because they are easily reduced to a lower valence state. However, the lanthanons which show only the (III) or higher valence in compounds appear to be reduced by a different mechanism, believed to entail formation of a hydrido species at the cathode surface. The rates of electrolysis of the (III) lanthanons vary widely depending on the electrolysis conditions, but the ratio of rates for any two of these lanthanons appears to be relatively constant. Separations can be predicted from the relative rates of electrolysis. (auth)

263

ON A SEPARATION OF HAFNIUM AND ZIRCONIUM BY ELECTROLYSIS OF FUSED SALTS. G. Chauvin, H. Coriou, and J. Huré (Centre d'Études Nucléaires, Saclay, France). Metaux (Cossosion—Inds.) No. 388, 6p. (1957) Dec. (In French)

The present study concerns separation of hafnium from zirconium by electrolysis, at 850°C, of a fused salt bath composed of 35 wt. % K_2ZrF_6 and 65 wt. % NaCl, K_2ZrF_6 containing different amounts (C_0) of hafnium as fluohafnate K_2HfF_6. The separation rate is extremely sensitive to electrolysis duration. At the beginning, it is of the order of 90 per cent for any initial hafnium concentration (C_0), at least for the range from 0.28 to 1.4 wt. % Hf. Afterwards it decreases quickly to 15 to 20 per cent at the end of each term. The hafnium concentration in the fused bath is increasing as soon as the electrolysis proceeds. It is verified that the separation rate, compared with this hafnium concentration in the bath, is constant with a value of 90 per cent from the beginning to the end of each electrolytic run. (auth)

264

THE EXTRACTION OF THE SALICYLATES OF SCANDIUM, YTTRIUM, CERIUM, LANTHANUM, URANIUM, AND THORIUM. B. N. Sudarikov, V. A. Zaytsev, Yu. G. Puchkov. Nauch. Doklady Vysshei Shkoly. Khim. i Khim. Tekhnol., No. 1, 80–3(1959).

The work is an attempt to attain the separation of the elements mentioned by means of the extraction taking place with complex formation. The extraction was controlled by the radioactive isotopes Sc^{46}, Y^{90}, Ce^{141}, La^{140}, and Th^{234}. Salicylic acid was chosen because it easily forms complex compounds with metals and is readily soluble in organic solvents. Isoamyl alcohol was used as a solvent. The distribution coefficient α of salicylates between the aqueous and organic phase was checked in dependence on the pH of the solution. The following substances were quantitatively

extracted: scandium salicylate at pH values between 3.3—5.5; yttrium salicylate at pH values higher than 4, lanthanum salicylate at pH values higher than 4.5; cerium salicylate at pH values higher than 5.0 and thorium salicylate at pH values higher than 3.0. Uranium salicylate was extracted between pH 2.5 to 5.5, with higher pH values; however, a crystalline precipitate is formed which was analyzed as $NH_4 UO_2(HSal^-)_3.4H_2O$. A straight line with the tangent of the inclination angle = 2 resulted from the coordinate system $lg(\alpha) - lg(H^+)$ with a constant salicylic acid concentration and from the system $lg(\alpha) - lg(HSal)_{org}$ at a constant pH = 2.2. Thus 2 H^+ ions are emitted in the reaction with salicylic acid. (TCO)

265

THE SEPARATION OF TANTALUM, NIOBIUM AND ZIRCONIUM BY FRACTIONAL DISTILLATION. L. A. Nisel'son. Nauch. Doklady Vysshei Shkoly Met. No. 3, 285(1958).

A rapid separation and purification of tantalum and niobium is carried out by the interaction of the pentachlorides with phosphorus oxychloride. The metal sample investigated, which had the composition 22.5% Nb, 59% Ta, and 18% Zr, was converted into chlorides and then was treated with phosphorus oxychloride. The following fractions were obtained: (1) Niobium fraction with about 86% Nb and 0.1% Ta. (2) Tantalum fraction with about 81% Ta and 0.015% Nb. Zirconium was not found in these fractions. The intermediate fractions contain tantalum, niobium, and zirconium and may be subjected to the fractional distillation another time. The method of the fractional distillation of pentachlorides in the presence of phosphorus oxychloride has some advantages as compared to the fractional distillation of the simple pentachlorides of niobium and tantalum. The reaction products of niobium and tantalum with phosphorus oxychloride are characterized by a higher volatility than the pentachlorides, and they also show a greater difference between boiling and melting temperatures. (TCO)

266

THE PHOTOLYTIC SEPARATION OF URANIUM FROM ALUMINIUM AND THORIUM, CERIUM AND LANTHANUM. K. Singh, Balaram Sahoo, and D. Patnaik (Ravenshaw College, Cuttack, India). Proc. Indian Acad. Sci., Sec. A 50, 129–31(1959) Aug.

The photolytic process of isolating the hydrated uranium complex $NH_4F \cdot UF_4 \cdot H_2O$ was applied to the separation of uranium from aluminum and a mixture of thorium, cerium, and lanthanum. Sunlight was used as the source of energy for the photolysis. It is reported that 100% pure uranium is obtained with a recovery of 99% pure uranium is obtained with a recovery of 99% from aluminum and 93 to 95% from thorium, cerium, and lanthanum. (C.J.G.)

267

PURIFICATION OF URANIUM FUELS BY SLAGGING AND FILTRATION. R. F. Taylor and D. L. Banfield (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Reactor Technol. 1, 77–83(1959) Aug.

Using uranium containing 0.1% Ce as a simple model of irradiated fuel, the degree of 'poison' removal by selfslagging methods was found to be comparable with that achieved at very low alloying concentrations. By filtration through oxide beds, removal of 95% Ce was obtained, the speed of processing being limited only by

the time required to reach operating temperature. Information is presented on the behavior of inclusions and the mechanism of cerium removal from the alloys. (auth)

268

THE SEPARATION OF SCANDIUM FROM THE RARE EARTHS AND ZIRCONIUM. E. A. Moskal'kova and Yu. M. Tolmachev. Trudy Radievogo Inst. im. V. G. Khlopina 7, 141-3(1957). (Translated from Referat. Zhur. Geol., No. 10, 1957, p.125).

A method was developed for separating Sc from the rare-earth elements and from Zr, based on the high solubility of $(NH_4)_3ScF_6$ and the insolubility of fluorides of the rare earths in a solution of ammonium fluoride. Zr is subsequently separated as a phosphate. To a solution containing rare earths, Zr, and Sc, a five-fold multiple of dry NH_4F is added. The resulting acid is neutralized with ammonia until it has a slight odor. The solution with the precipitated sediments is heated to 60°. The sediment is centrifuged and washed in a 5% solution of ammonium fluoride. The washing water is added to the filtrate and is treated in platinum with a 30% solution of KOH. The solution with the alkali is then heated to boiling. Sc and Zr, having been precipitated as hydrates, are filtered off, washed in hot water, and dissolved in a 15% solution of H_2SO_4. Freshly prepared doubly decomposing ammonium phosphate is added to the resulting solution in order to precipitate the Zr. Sc remains in the filtrate, from which it is precipitated as a hydrate by alkali. The $Sc(OH)_3$ sediment is filtered off, carefully washed from the PO_4^{3-}, and dissolved in a small quantity of 2 normal HCl. It is then diluted with water to such a volume that the acid concentration is 0.3 normal; and the Sc is precipitated from the solution by oxalic acid. The Sc oxalate thus obtained is centrifuged, washed in a 0.1% solution of oxalic acid, and roasted to form an oxide.

ENGINEERING AND EQUIPMENT

General and Miscellaneous

269 AECU-4383

Johnston (William H.) Labs., Inc., Lafayette, Ind. IN SITU TRACERS PROJECT. Quarterly Progress Report No. 2 [for] June—August 1959. 32p. Contract AT(11-1)-650. OTS.

Theoretical studies are reported on an evaluation of the potential usefulness of in situ tracers in industrial application of radioisotopes. Proposed maximum isotope concentrations for in situ tracers are tabulated for tritium, carbon-14, iodine-131, iodine-132, iron-59, magnesium-56, phosphorus-32, potassium-42, sodium-24, sulfur-35, yttrium-90, and zinc-65. Theoretical derivations were made to evaluate the required levels of tracer concentration as a function of instrument background, efficiency of detector, required statistical reliability, and tracer nuclide. Possible areas where radioisotopes can be used in the paint industry were surveyed. As a result of conferences with representatives of the National Paint, Varnish and Lacquer Association it was decided to place emphasis on the development of tracer methods for the measurement of air pollution from the paint industry, studies on film deterioration, and measurements of film thickness of paints. Progress is reported on the design and construction of low-level soft beta counters and a large

low-level liquid scintillation gamma counter for industrial use. Preliminary design drawings are included. (C.H.)

270 APEX-522

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati. ANALYSIS OF VANE-TYPE AIR MOTORS. B. Kaplan. Nov. 1957. 25p. Contracts AF33(600)-38062 and AT(11-1)-171. OTS.

The engineering analysis of the problem of optimizing the design of vane-type pneumatic motors that can be employed at high temperatures in the control of nuclear reactors is presented. The report contains the thermomechanical analysis leading to the necessary set of equations that enable the digital computer to design automatically vane-type air motors for given specifications and also enable parametric studies to be performed. (auth)

271 CF-59-9-4

Oak Ridge National Lab., Tenn. STRESS ANALYSIS OF BEAM GRILLAGES. F. J. Stanek. Sept. 1959. 51p. OTS.

The application of the matrix theory to the solution of beam grillage problems is demonstrated. The procedure is confined to beam grillages with symmetrical arrangements, and the tabulated beam formulas are only for symmetrical loaded beams. The procedure is explained by carrying through several illustrative examples in detail. The procedures may be extended to other grillage arrangements. Formulas and procedure required for incorporation of shear strain effects in deflection calculations are included. (J.R.D.)

272 SC-4333(TR)

Sandia Corp., Albuquerque, N. Mex. THE SANDIA DUST TUBE: DEVELOPMENT AND AN EXPERIMENT. John R. Banister and Wade T. Parker. Sept. 1959. 39p. OTS.

A 5.5-inch-diameter wind tunnel delivering dust-laden air was designed and constructed. An analysis employing mass and momentum conservation was developed, to provide a method of specifying the tube output from measurements of input conditions, with uncritical use of specialized dust instruments. The tube is capable of producing suspended dust-to-air density ratios up to more than 1, at flow speeds up to 485 feet per second. The tube performance is, however, somewhat erratic. Improvements are planned to stabilize its operation. An experimental study of dust drag coefficients was carried out with the dust tube. It was found that with dust of 100-micron mass mean diameter, the coefficients for a disk, sphere, and cylinder are about 1, $\frac{1}{2}$, and $\frac{2}{3}$, respectively. This result is as predicted for the disc. For the other targets, the measured values fall at the low end of the ranges indicated by theory. (auth)

273 SCTM-9-55(12)

Sandia Corp., Albuquerque, N. Mex. CONTROLLED VENTING OF STORAGE AND SHIPPING CONTAINERS. G. V. Lemmon. Jan. 31, 1955. Changed from OFFICIAL USE ONLY Oct. 21, 1959. 14p. OTS.

A recommendation is made that future containers designed by Sandia Corporation for the protection of large ordnance items be provided with open vents for controlling the moist air "breathed," to an amount which can be economically controlled by the inclusion of a desic-

cating agent. A group of six tests are cited, with their results, as evidence upon which this recommendation is made. A formula is presented for calculating the amount of desiccant necessary to maintain the relative humidity below 30% (considered to be a safe value from the standpoint of corrosion) for one and one-half years' storage under severe storage conditions. (auth)

274

ULTRA HIGH PRESSURE FOR MATERIALS RESEARCH. Charles M. Schwartz and Wendell B. Wilson (Battelle Memorial Inst., Columbus, Ohio). Battelle Tech. Rev. 6p.(1959) June.

Techniques for achieving unusual combinations of extreme pressures and high temperatures are described. The effects of pressure on liquids and solids and ultra-high pressure apparatus and applications were studied. (J.E.D.)

275

INDUSTRIAL APPLICATIONS OF RARE EARTHS (BASED ON DATA IN FOREIGN JOURNALS). B. I. Kogan. Byull. Nauch. Tekh. Inform. Ministerstva Geol. Okhrany Nedr S.S.S.R., No. 5, 24-7(1957). (Translated from Referat. Zhur. Met., No 9, 1958, p.282).

The rare-earth elements (REE) are widely used in nuclear engineering. Ceramic and refractory materials using Ce, La, and other REE have been developed for nuclear reactors. The REE are employed in metallurgical processes as deoxidizers, degassing agents, and desulfurizers, and serve as inoculants, for improvement in mechanical properties of various alloys (pig iron, steel, Mg alloys and others). Polishing powders of the REE (chiefly a specially treated Ce oxide) are superior to all known polishing materials. In addition, REE are employed to make incandescent carbons, luminescent materials, pyrophoric alloys, explosives, medicaments, etc. Application of REE in nuclear engineering, ferrous and nonferrous metallurgy, light alloys, glasses, ceramics, refractories, illumination engineering, electrical and electronic engineering, the chemical industry, military engineering, and others are listed.

276

BAUXITE AS A FILLER FOR CONCRETES USED FOR RADIATION PROTECTION. Gyorgy Kunszt. Építőanyag 10, 23-7(1958). (Translated from Referat. Zhur. Khim. No. 4, 1959, Abstract No. 12654)

The content in bauxite (B) of hydrate water (12−20%) leads to a proposal for its use instead of limonite in concretes used for radiation protection. Since the neutron capture cross-section is limited by the content of hydrogen in concrete, a conclusion can be drawn as to the necessity for using B in which the content of hydrate water that enters into a unit of volume is greater than in limonite. Adding a small quantity of scrap metal to the concrete mixture can compensate for an insufficiency of B.

Heat Transfer and Fluid Flow

277   AAEC/E-37

Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales. STUDIES OF SMALL PARTICLE SUSPENSIONS FOR L.M.F.R. PART IV. CONCENTRATION GRADIENTS IN FLOWING SUSPENSION. R. C. Cairns and K. R. Lawther. July 1958. 32p.

A radiometric method and the apparatus used to measure concentration gradients in flowing suspensions are described. Both Ir^{192} and Tm^{170} sources were used to measure gradients. Transverses of both a horizontal and a vertical pipe, in which a tungsten-water suspension was flowing, were made. Plots are given for various velocities of the concentration distribution in wt. % W across the pipe at right angles to the direction of flow. Very turbulent conditions, with velocities in excess of 13.4 fps (Re > 161,000) in a 1-in.^{2} pipe are needed before uniform suspension would be achieved. At 13.4 fps the difference in concentration from top to bottom of the pipe amounts to approximately 6% of the bottom concentration. Much larger concentration gradients exist at lower velocities. In vertical flow no measurable concentration gradients exist for mean velocities of 2.6 to 6.3 fps (Reynolds number 29,000 to 74,000) in a 1-in.^{2} pipe. Striations noticed in previous work near the settling point were observed. (auth)

278   CF-51-10-178(Del.)

Oak Ridge National Lab., Tenn.
TEMPERATURE DISTRIBUTION IN THIN WALLED HEAT-EXCHANGERS HAVING NONCIRCULAR FLOW PASSAGES. W. S. Farmer. Oct. 23, 1951. Decl. with deletions Feb. 19, 1957. 15p. OTS.

In heat exchangers, in which the walls are heated by internal heat sources, it is possible for wall temperatures greater than the mean to occur in the corners of noncircular flow passages. Thus in a square or triangular passage low velocities occur in the corners, and the resulting decrease in the heat transfer coefficient produces higher temperatures in the walls at these locations. A generalized analysis is presented, taking into account the variation in the heat transfer coefficient along the surface, by which it is possible to compute local temperatures in the walls of noncircular flow passages in the vicinity of the corners. Computations have been made for a representative component composed of a honey comb of rectangular passages. The resulting temperature at the hottest point is approximately 125°F greater than the uniform plate temperature. This analysis is based on a 90° angle between the plate and retaining plate, and a uniform source distribution throughout all plates. Had the angle between the primary plate and retaining plate been much less than 90° on both sides, then the resulting local temperature rise would be several times the above value. If the primary plate and retaining plate are "dead" at junctions and corners then of course a "hot spot" will not occur at these locations. (auth)

279   NAA-SR-3747

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
EXPERIMENTAL EVALUATION OF A CONCENTRIC-CYLINDER, SPIRAL-FLOW HEAT EXCHANGER. J. S. McDonald. Oct. 15, 1959. 35p. Contract AT-11-1-GEN-8. OTS.

An experimental evaluation was made of a 100-kw model of a concentric cylinder, countercurrent, spiral-flow heat exchanger to determine its applicability in sodium-cooled reactor systems. The heat exchanger underwent a rigid program of rapid thermal transients, and the unit demonstrated a satisfactory resistance to thermal stresses. Heat transfer tests also were conducted, and expressions were developed for the liquid metal Nusselt numbers associated with two general heat transfer conditions for the essentially rectangular cross sections of the fluid passages. For net heat

transmission through two opposite walls, where Nu is the Nusselt number and Pe is the Peclet number, the relation found was Nu = $0.055Pe^{0.8}$. For a similar geometry with heat flow through only one wall, the relation found was Nu = $0.15 + 0.12Pe^{0.8}$. (auth)

280   NP-7984
Massachusetts Inst. of Tech., Cambridge.
NUCLEATE BOILING BUBBLE GROWTH AND DEPARTURE. Technical Report No. 16. Bogumil E. Staniszewski. Aug. 1959. 31p. DSR Project No. 7-7673. Contract NONR-1841(39).

The vapor bubble formation on the heating surface during pool boiling has been studied experimentally. Experiments were made at the atmospheric pressure 28 psi and 49 psi, using degassed distilled water and ethanol. The heat fluxes and heating surface temperatures have been measured simultaneously by taking high speed motion pictures of growing bubbles. The diameter time curves of the bubbles and their diameter at the departure moment were obtained in these investigations. Bubble growth rates and bubble departure sizes have been compared to existing theories. It has been found that existing growth theories do not agree very well and that the departure size of the bubble is a function of the growth velocity. (auth)

281   NYO-2543
New York Univ., New York. Atomic Energy Commission Computing and Applied Mathematics Center.
EQUATIONS OF FLOW IN A RAREFIED ATMOSPHERE. Harold Grad. June 17, 1959. 39p. Contract AT(30-1)-1480. OTS.

The problem of the aerodynamic or flow properties of the upper atmosphere is characterized by the presence of a large number of simultaneous and interacting phenomena and a large range of values taken by the relevant physical parameters with an ensuing bewildering array of different flow regimes. A survey of some of the more interesting limiting cases is made, and only briefly the multitude of transition regimes is mentioned. As an illustrative problem, the "free flow" around an object much smaller than the mean-free-path is considered. Surprisingly, whether or not this problem should be handled by the traditional free molecular flow techniques, or by continuum techniques, or as a problem in transition flow turns out to depend on what question has been asked. In particular, one can find in this single problem all the features of the various flow regimes for arbitrary Knudsen number as well as Mach number. The asymptotic flow at infinity can be described by an appropriate solution of the macroscopic non-dissipative Euler equations including a wake behind the body and a shock wave in the supersonic case. The fine structure of the wake is similar to the classical Oseen solution. Exactly the same asymptotic behavior is obtained for the flow around a body of arbitrary size (not in free flow). Thus the asymptotic flow depends on Mach number only and not on Knudsen number. (auth)

282   WADC-TR-59-87(Pt. I)
Chicago. Univ. Chicago Midway Labs.
DETERMINATION OF FACTORS GOVERNING SELECTION AND APPLICATION OF MATERIALS FOR ABLATION COOLING OF HYPERVELOCITY VEHICLES.
[Period covered]: December 1, 1957 to November 30, 1958. John H. Bonin, Channon F. Price, and Donald E. Taylor. Jan. 29, 1959. 142p. Project title: MATERIALS ANALYSIS AND EVALUATION TECHNIQUES. Task title: THERMODYNAMICS AND HEAT TRANSFER. Contract AF33(616)-5436. OTS.

The results are presented of an investigation for which the prime objective was the determination of the behavior of materials exposed to thermal environments representative of re-entry conditions. The environment encountered by ballistic, glide, and skip vehicles is reviewed. Heat flow into single and composite slab materials for heat sink applications is discussed. The development and calibration of an air-stabilized arc facility of a nominal 1000-kw rating is described. In the experimental phase of the investigation, representative materials were exposed to the high-temperature plasma discharge produced in stabilized arcs. The results obtained are reported upon, along with a correlation of the observed behavior with theory. (auth)

283   WAPD-AD-TH-470
[Westinghouse Electric Corp. Bettis Plant, Pittsburgh].
NATURAL CIRCULATION OF WATER AT 1200 PSIA UNDER HEATED, LOCAL BOILING AND BULK BOILING CONDITIONS: TEST DATA AND ANALYSIS. A. S. Rathbun, N. E. Van Huff, and A. Weiss. Dec. 1958. 50p. OTS.

The natural circulation tests performed and analyzed in this report were conducted at 1200 psia on the Bettis Natural Circulation Loop, No. 29. The tests were run with two different single channel test sections (0.101 in. × 1 in. × 27 in. long and 0.210 in. × 1 in. × 27 in. long). Heat fluxes ranged from 50,000 $Btu/hr-ft^2$ to departure from nucleate boiling and inlet subcooling was fixed at 109°F. The results show that there is no difference between natural and forced circulation pressure drop and riser density. (Other tests recently completed but not reported here show similarly that there is no difference between forced circulation and natural circulation DNB providing there are no large deviations of flow due to instabilities.) The tests also show that loop circulating flows in Loop No. 29 can be predicted quite accurately in single-phase flow. Circulation rates with two-phase flow can be accurately predicted if two-phase entrance and exit losses and steamwater slip ratios are known. Further, flow instabilities were noted under certain conditions and occurred before DNB. With the 0.101 in. × 1 in. × 27 in. long test section these instabilities were large enough to cause a DNB. However, at the same conditions no apparent instability was noted with the 0.210 in. × 1 in. × 27 in. long test section. Some data for slip ratios in two phase flow at inlet velocities less than 1 ft/sec were obtained. Additional tests with other channel sizes and at other pressures have been completed and data reduction is in progress. (auth)

284   WAPD-TH-478
[Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.]
RESULTS OF FINAL HIGH HEAT FLUX TESTS AT 2000 PSIA ON PARALLEL FLOW RODS. A. Weiss. Feb. 9, 1959. 8p. OTS.

High heat flux tests were conducted with vertical upflow of water at 2000 psia using a test section having nine heated rods (0.413 in. diameter × 0.468 in. square pitch × $9\frac{1}{4}$ in. long). These tests confirmed the validity of using the present Bettis design procedure based on tests with rectangular channels, for calculating DNB heat flux for parallel flow through heated rod bundles. The tests were run with mass velocities from 0.25 to $1.0 × 10^6$ $lb/hr-ft^2$, at inlet temperatures from 400 to 625°F. Although because of instrumentation difficulties only 2 actual meltdown points were obtained, it was still shown that in the range of variables covered the use of

the DNB design equation for rectangular channels will yield conservative values of DNB heat fluxes for flow outside of parallel rod bundles. The results represent the completed DNB program for parallel flow through PWR type rod bundles. (auth)

285   WAPD-V(FBE)-274

Westinghouse Electric Corp. Bettis Plant, Pittsburgh. MECHANISM OF VOID FORMATION TEST FACILITY. A. J. Martenson, S. W. Sinderson, and W. R. West. Aug. 20, 1959. 28p. Contract AT-11-1-GEN-14. OTS.

A test program to investigate the mechanism of void formation and to determine the amount of voids that can be maintained under conditions of high pressure and high flow is reported. The program includes a literature survey and a test program. The test facility which will be used in this program is a loop which is designed to operate with water at pressures up to 2,000 psi and at temperatures up to 650°F. It consists of several basic groups; test apparatus, the loop assembly, and external test equipment. The test apparatus contains the heated element; the loop assembly provides the proper conditions for the test; and the external equipment provides power and the data recording equipment, including a high speed camera. Each of these groups is described. (W.L.H.)

286

ON SOME PROBLEMS OF HEAT TRANSFER IN FREE MOLECULE FLOW. M. Z. v. Krzywoblocki and F. H. Bergonz (Univ. of Illinois, Urbana). Acta Phys. Austriaca 12, 400-11(1959).

The general theory for aerodynamic heating in free molecule flow is briefly presented. This is then applied to a cone and a paraboloid of revolution in an attempt to predict surface temperatures. Only the aerodynamic effects are considered, i.e., the entire heat transfer to the body is made by the energy exchange of the gas molecules only. No effect of radiation to or from the body is considered. (auth)

297

LIQUID-METAL HEAT TRANSFER MEDIA. S. S. Kutateladze, V. M. Borishanskii, I. I. Novikov, and O. S. Fedynskii. Translation of Atomnaya Energ., Suppl. No. 2, 1958. New York, Consultants Bureau, Inc., 1959. 152p. $22.50.

The thirteen chapters in this volume cover the following subjects: basic properties of liquid metals, application of liquid-metal heat-transfer media, hydraulic resistance in the flow of liquid metals, turbulent heat transfer in liquid metals, heat transfer during flow in tubes, heat transfer during longitudinal flow around a plate, heat transfer during transverse flow around cylinders, heat exchange during free convection, heat transfer during vapor condensation, heat exchange during boiling, heat-exchanging equipment, stability of heat-resistant materials in liquid metals, and instrumentation. (W.L.H.)

283

ON THE NATURE OF THE HEAT EXCHANGE IN CURVILINEAR DUCTS. N. V. Tsarenko. Izvest. Kiev. Politekh. Inst. 18, 358-61(1956). (Translated from Referat. Zhur. Mekhan. No. 3, 1957, p.75).

On the basis of experimental results on the heat exchange in straight and curved pipes and of a comparative analysis of the kinetic structure of turbulent fluid flow inside a plane rectangular and square duct it is deduced that the heat exchange occurring under turbulent-flow conditions in curvilinear ducts of rectangular section with an elevated ratio of the sides (b/h > 8 + 9) is described sufficiently accurately by the equation N = 0.023 $R^{0.8}$ $P^{0.4}$ where N is the Nusselt number, R is the Reynolds number, and P is the Prandtl number.

289

FLOW-INDUCED NOISE IN HEAT EXCHANGERS. A. A. Putnam (Battelle Memorial Inst., Columbus, Ohio). J. Eng. Power 81, 417-22(1959) Oct.

Noise or vibration problems in heat exchangers may be encountered in those instances when a natural acoustic frequency of the exchanger in the direction normal to the flow direction and tube length is close to the frequency determined by the Strouhal number. In this case coupling can occur giving oscillation of a large amplitude which results in an excessive pressure drop. If the banks of tubes are closely spaced, interaction takes place between the vortexes shedding from the various banks of tubes. Experiments on pairs of tubes, in-line tubes, and staggered tubes show the Strouhal number no longer has a value of about $\frac{1}{5}$, as for a single isolated tube, and the critical dimension may be tube spacing rather than tube diameter. Several types of equipment alterations found useful in noise suppression are given. (C.J.G.)

290

COMPRESSIBLE TURBULENT BOUNDARY LAYERS WITH HEAT TRANSFER AND PRESSURE GRADIENT IN FLOW DIRECTION. Alfred Walz. J. Research Natl. Bur. Standards 63B, 53-70(1959) July-Sept.

The best-known theoretical works on boundary-layer problems, especially in the case of compressible flow without or with heat transfer, are related to the laminar boundary layer, although the turbulent boundary layer is, in practice, often more interesting. The laminar boundary layer is more easily accessible to theoretical treatment because clearly defined relations exist between the viscosity μ and the shear stresses τ. In the turbulent case, empirical relations must be introduced. Therefore, attempts to get exact solutions are not worthwhile, while efforts to obtain approximate solutions, based for instance on the von Karman-Pohlhausen principle of utilizing integral conditions, appear to be appropriate to this problem. In the last few years the accuracy of such approximate solutions for the incompressible case was noticeably improved by the application of a new energy integral condition in connection with a new empirical law for the dissipation in turbulent boundary layers, stated by J. Rotta and E. Truckenbrodt. The empirical laws for dissipation and for turbulent wall friction, which are needed in the present approximate theory, are formulated on the basis of available measurements for incompressible flow. Generalization to the compressible flow with heat transfer is made from physical considerations. Calculated results agree satisfactorily with available experimental data. Some possibilities for improving as well as for simplifying the approximation theory are outlined. (auth)

291

HEAT EXCHANGING APPARATUS OF HIGH INTENSITY. A. B. Dassel and N. I. Gel'perin. Khim. Nauka i Prom. 3, 493-67(1958).

In chemical plants there are thousands of m² of heat exchanging surface. It is important, therefore, to use in every case the most efficient type. Heat exchangers with longitudinal ribs are described. In many cases

breaks are made in the ribs in order to increase the turbulence of the air. Heat exchangers with cross ribs have higher heat emission coefficients than those with longitudinal ribs. The surface of other exchangers is increased by deforming the pipes. A comparison of these exchangers with smooth pipes is given. The pipes of heat exchangers may be wound by corrugated metal tapes. The ribbing may also be made of wire. The characteristic of this device is presented. Air coolers with such a ribbing have a heat emission from 50 to 140 kcal/m^2 h. The heat emission in all exchangers may be intensified by turbulizing inserts of various shape within the pipes. If diaphragms are installed in the pipes, the heat emission is also increased. The coefficients of heat emission for exchangers with flattened tubes are presented. The McMahon heat exchanger is described. The laminated-ribbed heat exchanger is represented by an apparatus manufactured by "Griskom Russel Co". Heat exchangers of the Collins type are used in oxygen plants. They consist of four concentric pipes. They have been investigated. Laminated gas heat exchangers with wave-shaped canals are described. The survey shows that there is no universal criterium for the efficiency of heat exchangers, but that in every case the choice must be based on the characteristic of the exchanger which is most useful for the task. (TCO)

292

HUNTERSTON FUEL ELEMENTS HEAT TRANSFER. E. W. V. Acton (General Electric Co., Wembley, Eng.). Nuclear Eng. 4, 347-51(1959) Oct.

The polyzonal axial fuel element, or Hunterston-type, has axial fins together with spiral flow separators or swirlers. Experimental results are presented in the form of plots of Stanton number and friction factor against Reynolds number. These results include: the effect of varying the lead and number of swirlers, the effect of increasing can and channel diameter, and the effect of increasing the number and size of fins. A general correlation of the Stanton number and friction factor, both as a function of Reynolds number, are given. (C.J.G.)

293

LOCAL PRESSURE GRADIENTS IN FORCED CONVECTION VAPORIZATION. V. E. Schrock and L. M. Grossman (California Univ., Berkeley). Nuclear Sci. and Eng. 6, 245-50(1959) Sept.

An experimental study of pressure drop in forced convection vaporization was made in a heat transfer loop designed for the investigation of local heat transfer coefficients and local pressure gradients for water flowing vertically upward in an electrically heated tube. Data presented are for $\frac{1}{8}$-in. i.d. 347 stainless steel tubes of 15 and 20-in. lengths with mass fluxes of 200 to 700 lb/sec ft^2, heat fluxes of 1 to 8 $\times$ 10^5 Btu/hr-ft^2, qualities at the exit up to 50% and with pressures ranging from 50 to 400 psia. A correlation of the local pressure gradients as a function of the Martinelli parameter X_{tt} was obtained to within $\pm 15\%$ and a design procedure for calculating over-all pressure drop from this correlation is suggested. (auth)

294

ON THE EMPLOYMENT OF RADIOACTIVE METHODS FOR AUTOMATIC CONTROL OF THE DISCHARGE RATE AND DUST CONTENT OF GASEOUS MEDIA. L. V. Mel'tser. Sbornik Rabot Avtomat. i Telemekh.

Moscow, Akad. Nauk S.S.S.R. 211-27(1956). (Translated from Referat. Zhur. Mekhan. No. 9, 1957, p.128)

The possibility of producing an ion cloud with a modulated radioactive emission is examined. A preliminary evaluation of measuring devices employed for automatic control of the discharge rate of a gas and regulation of the degree of its contamination with dust by the method of ion cloud migration is given. The use of radioisotopes to combine the determination of dust contamination of a gas with the measurement of the discharge rate by the electrical discharge method is discussed.

295

A METHOD OF CHECKING THE DESIGN COMPUTATIONS OF HEAT EXCHANGERS. N. B. Kadirov. Trudy Azerboidzhan. Ind. Inst. im M. Azizhekova, No. 11, 119-31(1955). (Translated from Referat. Zhur. Mekhan., No. 3, 1957, p.82(1957)).

Methods of proving design computations for tubular heat exchangers are presented. The procedure is regarded as a problem in the determination of the final temperatures of hot and cold liquids, and the quantity of heat transferred in accordance with temperatures which are involved, and water equivalents of the liquids in relation to the fixed parameters of the heat exchanger. In addition to the thermal resistance of the walls, the tendency of metal to change its thermal conductivity with varying temperatures, and the temperature dependence of the specific heat of the liquids is also taken into consideration. It is shown that the problem may be reduced to a system of equations (the number of which is a function of the flow regime of the liquids). It is recommended that the resulting system of equations be solved by the method of successive approximations. Explanations are given regarding the application of the computational method proposed to specific instances of parallel-flow and counterflow-type heat exchangers operating under conditions of turbulent and laminar flow of liquids.

296

COMPARISON OF HEAT EXCHANGERS OF THE "FLUIDIZED-BED" AND "COMPACT-BED" TYPES FOR UTILIZING THE HEAT OF EXHAUST GASES. S. S. Zabrodskii. Trudy Inst. Energet. Akad. Nauk Belorus. S.S.R., No. 2, 162-77(1955). (Translated from Referat. Zhur. Mekhan. No. 7, 1957, p. 79).

A discussion is carried on concerning the characteristics and a simplified model of a device for generating a fluidized (or semisuspended) bed which is created by blasting a stream of gas (of sufficient velocity) upward through a naturally-resting but not compressed compact layer of a granular substance. The particles of this layer are in motion outwardly resembling the seething of a boiling liquid. The possible limits of stability of the boiling layer are ascertained. The data obtained are presented in the form of tables and charts, on the basis of which it is demonstrated that the utilization of the fluidized bed makes it possible to obtain high-efficiency heat-exchange devices for the utilization of the heat of exhaust gases. It was established that an idealized homogenous fluidized bed is considerably more productive in respect to the heat stress per unit volume than the compact bed (particularly near the condition of fully developed boiling when the particles do not come in contact with one another but float). It is pointed out that in this case there is no local overheating of the air because of the ex-

tensive intermixing of the particles (it is even possible to dry combustible materials by means of high-temperature gases). It is asserted that for thermal treatment of a multi-fraction disperse substance the fluidized bed is better than the compact bed since it does not require the separation of light fractions which increase the heat resistance of the compact-bed-type heat exchangers. Basic shortcomings of the fluidized bed as compared with the compact bed are noted. In conclusion it is stated that a further investigation of the fluidized and compact beds in action presents a practically important problem, since these layers of granular substances even with a negligible layer thickness and small hydraulic resistance are apparently able to ensure an extensive cooling of the gases passing through them. (TCO)

297

A METHOD FOR THE DETERMINATION OF THE INTENSITY OF HEAT EXCHANGE IN MOLTEN METALS BY FREE CONVECTION. A. I. Veynik. Trudy Inst. Energet. Akad. Nauk Beloruss. S.S.R. No. 3, 62-7(1957). (Translated from Referat. Zhur. Met., No. 10, 1958, p.187).

To determine the intensity of heat exchange in molten metal by free convection the use of the method of an immersion method is proposed in which a specimen (S) of suitable shape and possessing a specified thermal resistance on the surface is immersed in the melt. During the interaction of S with the molten metal the heat flow passing into the S at first is considerable, which causes the formation of a hardened crust of a certain thickness on the surface of S. Then, with progressive heating of the S, the heat flow decreases and the hardened crust gradually melts. This is explained by the fact that the amount of heat enetering the S through the crust becomes smaller than the amount of heat transferred to the crust from the molten metal. The resulting excess of heat is expended on the melting of the crust. If the S is removed from the molten metal bath before the crust is completely melted, then it is possible to judge the magnitude of the heat flow and the value for the coefficient of heat transfer from the thickness (or weight) of the remaining solid metal. To put the proposed method into practice formulas are developed for the relationship between the thickness of the hardened crust and the value of the heat-transfer coefficient. To simplify the problem it is assumed that the thickness of the hardened crust is small compared to the dimensions of the S, and, therefore, in the thermal sense, the crust is regarded as a plane partition. Moreover, the temperature drop occurring within the crust as a result of the cooling of its inner surface (in contact with S) below the temperature of crystallization is disregarded.

298

AN INVESTIGATION OF THE TEMPERATURE CONDITIONS IN THE OPERATION OF A VERTICAL BOILING TUBE UNDER SUPERHIGH PRESSURES. M. A. Styrikovich and M. Ye. Shitsman. Vsesoyuz. Sbornik Gidrodinam. i Teploobmen Kipenii v Kotlakh Vysokogo Davleniya, 206-28(1955). Moscow, Acad. Nauk S.S.S.R. (Translated from Referat. Zhur. Mek. No. 3, 1957, p.80).

The results of an investigation of the temperature regime in a 30 mm diameter vertical boiling tube were investigated. The experiments were conducted on a stand with pressures at 182 to 209 atm abs, specific heat flux at 230 to 720,000 kcal/m²/hr, circulation velocities at 0.2 to 2.2 m/sec, and gravimetric steam content at 8 to 100%. It is established that a considerable range of intermediate regimes exists within the zone of pressures and circulation parameters investigated, during which, the intensity of the heat transfer gradually decreases from the values corresponding to a normal nucleate boiling to the values which correspond with heat transfer to dry saturated steam. It is pointed out that with specific heat fluxes of 400 to 450,000 kcal/m²/hr a decrease in the circulation velocity to 0.4 to 0.5 m/sec and of the circulation multiplicity to 2.0 to 2.5 may lead to damage to the steam pipes of boilers operating at high pressures.

299

TEPLOPEREDACHA I TEPLOVOYE MODLIROVANIYE. (Heat Transfer and Modeling of Heat Processes). M. A. Mikheyev, ed. Moscow, Izd-vo AN SSSR, 1959. 419p.

A collection of papers comprising the results of investigation of heat transfer processes and the efficiency of heat apparatus are presented. Résumés of the work of 26 authors summarize work done in this field with particular emphasis of heat transfer and hydraulics of liquid metals. (J.R.D.)

Instrumentation

300   AECU-4291

California Research Corp., Richmond, Calif.
CIRCULATING LOOPS FOR TESTING ORGANIC COOLANTS. Survey and Status. J. G. Carroll. June 30, 1959. 74p. Contract AT(11-1)-174. OTS.

A survey was made of past equipment and that planned through Calendar 1959. Conferences were held with most of the loop operators; in addition, the open literature was consulted. Short résumés are appended for nine in-pile loops, one gamma source loop, and five out-of-pile loops. The text briefly presents the background and need for such test work. (auth)

301   AECU-4349

ITT Labs. Div. of International Telephone and Telegraph Corp., Fort Wayne.
A FEASIBILITY STUDY OF OPTICALLY REGENERATIVE LIGHT INTENSIFIER. Final Report for Period July to December 1958 and Extension Period January to February 1959. 23p. Contract AT(11-1)-648. OTS.

From image-tube measurements it was learned that the S-11, P-11 photocathode phosphor combination should have sufficient gain for regenerative operation in a close-spaced, 5-kv intensifier with a resolution of approximately 1 line pr/mm. This intensifier requires operation of a voltage gradient in the order of 10^5 v/cm, which would not be possible if components were contaminated by cesium. From the eight tubes constructed and evaluated, it was seen that the operation of the intensifier at the desired voltage and spacing requirements was possible and depended solely upon the condition of the intensifier elements. Operation of these tubes showed that the individual electron streams from each fotoform hole could be resolved and controlled. Full regenerative operation of the tubes was not seen; however, feedback coefficients of 0.5 and 0.15 were obtained with substandard cathodes. These measurements indicated that full regenerative operation would be feasible by use of an S-11 photocathode of about 30 μa/ lumen sensitivity, which is near the average sensitivity for this type of cathode, and higher resolution would be

feasible if more modern photocathodes with several times the sensitivity were used. (auth)

302 AERE-Bib-125

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
THERMOCOUPLES FOR HIGH TEMPERATURE MEASUREMENT. · A BIBLIOGRAPHY. A. C. Foskett. July 1959. 20p. BIS.

A bibliography of 106 references covering the period 1954 to March 1959 is presented. The sources checked included Nuclear Science Abstracts, 1954 to 1959, Science Abstracts A and B, 1954 to 1958, Engineering Index, 1954 to 1957, Applied Science and Technology Index, 1957 to 1959, and indexes at AERE, Harwell. (J.E.D.)

303 AERE-C/M-364(and Amdt.)

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
A GLASS ENCLOSED GAS CIRCULATING PUMP. N. S Corney, H. B. F. Gow, and R. B. Thomas. Feb. 1959. Reprinted with Amendment to Fig. 2, Aug. 1959. 12p. BIS.

A gas circulating pump which is operated electromagnetically is constructed so that the flowing gas comes into contact only with glass or silica surfaces. Reliable operation for long periods of time is ensured by the use of thyratrons to switch the current through the coils, the thyratrons being operated by a multivibrator circuit. (auth)

304 AERE-M-429

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
THE CALIBRATION OF FLOW IONISATION CHAMBERS FOR TRITIUM MONITORING IN AIR. R. M. Fry. Aug. 1959. 15p. BIS.

A stream of air of known tritium (HTO) concentration is obtained by mixing dry air and air saturated with HTO vapor in known proportions. This was used to calibrate ion chambers for the monitoring of tritium in air. Particular attention is paid to the 1590A, a chamber designed at A.E.R.E. Harwell, and limitations in its use as an air monitor due to adsorption of HTO are briefly discussed. (auth)

305 AERE-R-3016

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
A DESIGN FOR A THERMOSTATIC BATH WITH A STABILITY OF ±0.025°C AND A CAPACITY OF 40 LITRES. R. F. N. Grazebrook. Aug. 1959. 24p. BIS.

A fully automatic method for stabilizing the temperature of a large volume of water, above ambient temperature, to a constancy of better than ±0.025°C is described. Use is made of a bistable temperature sensitive element which relies on the expansion of a fluid. The heating power is switched in incremental steps which are small compared with the maximum heat input. (auth)

306 CEA-889

France. Commissariat à l'Énergie Atomique, Paris.
NOTES SUR LES CIRCUITS DE BASE PASSE BANDE. (Notes on Basic Band-pass Circuits.) J. Ailloud. Apr. 1959. 60p.

Resistance-coupled amplifier stages, elementary RC band-pass circuits, and the classical resonant circuit all have the same transfer function. The common properties and differences in behavior due to orders of size are pointed out so that it is possible to assign parameters as a function of the problem to be solved. Next the case of several stages or several circuits in cascade is considered where there is no interaction between them. (tr-auth)

307 CEA-915

France. Commissariat a l'Energie Atomique, Paris.
ÉTUDE ET RÉALISATION D'UN CANON A IONS DU TYPE HAUTE FREQUENCE A DEBIT ELEVÉ. (A High-current High-frequency Ion Gun.) J. Coutant, F. Prévot, and R. Vienet. 1959. 43p.

Development of a 10-ma proton beam source is described. A study was made of the production of intense plasma, in particular, the discharge mechanism, characteristics of high-frequency discharges, determination of the impedance of an oscillating circuit loaded with a plasma, the high-frequency electric field created by the self-induction of an oscillating circuit, and the definite source. Beam extraction is next considered with particular reference to space-charge. An extraction apparatus and experiments with it are. described. A three-electrode apparatus for beam focusing is described. Performance data are given as curves of power consumed, gas consumption, and extraction yield as a function of target current. (T.R.H.)

308 CF-55-2-111(Del.)

Oak Ridge National Lab., Tenn.
CALIBRATION OF THE REVALET, A REMOTELY VARIABLE LEAD-TRANSMISSION GAMMA-RAY DOSIMETER. D. L. Gilliland. Feb. [1955]. Decl. with deletions Feb. 20, 1957. 14p. Contract [W-7405-eng-26]. OTS.

In order to aid in the optimization of gamma-ray shielding, a method has been developed in which increments of lead shielding can be easily added to simulate a gamma shield. This is effected by enclosing an anthracene scintillation counter in a thick lead shield which has an aperture in one side that can be covered with 0- to 0.7-in.-thick lead discs. This instrument (the Revalet) has been experimentally operated in a known geometry with a source of known energy (Co^{60}). A comparison of the measured lead attenuation with Monte Carlo calculations indicated excellent agreement for 0 and 30° angles of incidence and good agreement at 60°. The cone angle of detection was 120°. (auth)

309 CNI-23

Italy. Comitato Nazionale per le Ricerche Nucleari.
Centro Nazionale per le Ricerche Nucleari, Ispra.
TIMER A DUE CICLI PER L'AUTOMATIZZAZIONE DELLE MISURE DI FISICA NUCLEARE. (A Two Cycle Timer for the Automation of the Measurement in Nuclear Physics). G. Colombo. Aug. 1959. 20p.

A timer capable of programming automatically a series of operations and particularly suited to meet the requirements of nuclear physics measurements is described. This apparatus determines the time duration of single measurements; at the end of each measurement it stops the scaler, makes the printer operate, resets the scaler, and drives the electromechanical devices, which modify the conditions of measurement. Either immediately after this is done, or after a predetermined interval, it makes a new measurement begin. Its operation is independent of

the frequency, and it relies upon an internal electronic clock, stabilized within 10^3 by temperature control. All circuits performing time generation (clock and frequency dividers), temperature stabilization, and servo-controls employ semiconductor devices throughout, with no tubes or relays. (auth)

310   HW-60974

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
THE OPERATION AND MAINTENANCE OF AN ALPHA ENERGY ANALYZING SYSTEM. F. P. Brauer and R. E. Connally. July 10, 1959. 33p. OTS.

The measurement of alpha energy has been used for the identification and analysis of alpha-active radionuclides. The method involves an ionization chamber in which the alpha particle loses all its energy in ionization of the chamber gas. The generated pulse is amplified and analyzed. The analysis can be used to estimate the alpha energy and in the case of several alpha emitters, the relative abundances can be determined. The operation, maintenance, and application of this alpha energy analyzer system are described. (W.D.M.)

311   JEN-58

Spain. Junta de Energia Nuclear, Madrid.
VÁLVULA ELECTROMAGNETICA AUTOMATICA PARA VACÍO PREVIO. (Automatic Electromagnetic Valve for Previous Vacuum). Carlos Enrique Granados and Francisco Martin. 1959. 5p.

A valve which permits the maintenance of an installation vacuum when electric current fails is described. The valve can also be operated to admit air into the vacuum bomb to prevent oil ascending into the vacuum tubes. (tr-auth)

312   JEN-59

Spain. Junta de Energia Nuclear, Madrid.
RESPUESTA DE DETECTORES DE CENTELLEO A PARTÍCULAS CARGADAS. (Behaviour of Scintillometers with Charge Particles). M. A. Vigon, J. Montes, C. E. Granados, and R. Gutierrez. 1959. 16p.

The behavior of a scintillation plastic and an anthracene crystal for protons and deuterons with energies between 0.2 and 1.7 Mev was studied. The monoenergetic particle beams fall directly on the detector which is in optical contact with a photomultiplier. The pulses are fed to an amplifier which transmits them to a scaler acting as a monitor and to a 100-channel analyzer. The spectrum for each energy of incident beam is obtained, taking the spectrum maximum as the most probable value for the amplitude of the detector response, and this is represented with respect to the energy. It is shown that for this energy range, the experimental curve is adjusted better by assuming that the detector response is proportional to the particle range in it than by using the semiempirical formula of Birks. (tr-auth)

313   JEN-62

Spain. Junta de Energia Nuclear, Madrid.
DESCRIPCIÓN DE LA FABRICACIÓN DE UN CONTADOR GEIGER-MULLER CON VENTANA. (Description of the Fabrication of a Geiger-Muller Counter with Window). Carlos Enrique Granados. 1959. 18p.

The components used in the fabrication of Geiger-Mueller counters and the method of fabrication for the counter are described. The installation and filling of the counters are also discussed. The materials that can be used and the precautions which must be adopted

in order to obtain counters with uniform operation and good characteristics are described. The counters discussed are of brass with thin windows of mica or aluminum and operate at 1100 v with a slope less than 5%/100 v. (tr-auth)

314   NYO-2396

Princeton Univ., N. J. Project Matterhorn.
AN ANALYTICAL METHOD OF DETERMINING POLE LOCATIONS OF CERTAIN TYPES OF FEEDBACK AMPLIFIERS. Publication No. 27. Rodger L. Gamblin. [Feb. 1959]. 16p. Contract AT(30-1)-1238. OTS.

The pole locations of feedback amplifiers of an arbitrarily large number of stages but with only one or two characteristic time constants can be solved analytically. The resulting expression is then general for all of a class of amplifiers. A solution of the case of "n" stages of one time constant and "m" stages of another with $n/m \gg 1$ is presented. The case with m = 1 and with ideal matched transmission lines in the loop is also solved. Other cases presented are for m = 0 and m = n. The analysis is shown to be good for high or low frequency investigations where the system bandwidth is broad enough to prevent high and low frequency response interference. (auth)

315   ORNL-2804

Oak Ridge National Lab., Tenn.
A VERSATILE INSTRUMENT CAMERA WITH A MICROSECOND ELECTRONIC SHUTTER. C. H. Schalbe. Nov. 2, 1959. 52p. Contract W-7405-eng-26. OTS.

There are three features of an electronic camera which set it apart from other high-speed photographic techniques. The shuttering problem is transformed from the mechanical realm to the control of an electron beam. This is an almost inevitable step in the development of high-speed devices since ease of control and freedom from jitter and vibration are such attractive qualities. The acceleration of the electrons provides a mechanism for introducing energy into the image. An image converter can produce an image of greater intensity than the object being photographed. This is a great advantage since high-speed photography is frequently hampered by the lack of brightness of the image due to the short time in which the film must be exposed. Synchronism to the event being photographed or generating a synchronizing pulse when the shutter is "tripped" is relatively simple. (auth)

316   PB-121838-S

Office of Technical Services, Washington, D. C.
NEL RELIABILITY BIBLIOGRAPHY. Supplement 1. [1956]. 161p. OTS.

The purpose of the bibliography is to promote reliability in the design and production of electronics equipment. A list of periodicals abstracted is included. Phases of electronics covered include circuit design, components, electron tubes, failure analysis, general, human engineering, maintenance, mechanical design, systems, and testing. (W.D.M.)

317   PB-121838-S1

Navy Electronics Lab., San Diego, Calif.
NEL RELIABILITY BIBLIOGRAPHY. Supplement 2. W. E. Jorgensen, I. G. Carlson, and C. G. Gros, comps. 1958. 90p. OTS.

A bibliography of material on the general subject of electronic equipment reliability is presented. The general subject is broken down to ten subtopics; circuit design, components, electron tubes, failure analysis,

general, human engineering, maintenance, mechanical design, systems, and testing. (W.L.H.)

318 SC-2990(TR)
Sandia Corp., Albuquerque, N. Mex.
MICROBAROGRAPH EVALUATION REPORT. Sept. 18, 1953. 56p. OTS.

The procedures used and the results obtained in evaluating the Wiancko type 3-PBM-2 microbarograph system are described. Requirements for the unit are somewhat rigid because it must be suitable for field use, it must be able to withstand salt spray, and because good accuracy is imperative. The manufacturing specifications are briefly stated and environmental testing is summarized. Calibration techniques are discussed. (W.D.M.)

319 SCTM-69-54(53)
Sandia Corp., Albuquerque, N. Mex.
RELIABILITY IN ELECTRONIC EQUIPMENT. F. J. Given. June 4, 1954. 11p. OTS.

The highlights of the findings of the Advisory Group on Reliability of Electronic Equipment are presented. The work has so far been based primarily on reliability of communication, fire, and navigation equipment. (W.D.M.)

320 SCTM-156-55(51)
Sandia Corp., Albuquerque, N. Mex.
HIGH VOLTAGE MERCURY SWITCH PULSE GENERATOR. F. M. McIver. Dec. 7, 1955. 7p. OTS.

A mercury switch, W.E. 218-a, used in a discharge line type pulse generator has the disadvantage of generating multiple pulses when operated at high voltages. This disadvantage is overcome by the insertion of a second mercury switch between the line and the voltage source. (auth)

321 SCTM-160-59(15)
Sandia Corp., Albuquerque, N. Mex.
THE FABRICATION AND APPLICATION OF SWITCHING AND COMMUTATING DRUMS. Wendell O. Johnson. May 11, 1959. 11p. OTS.

Three distinct types of switching drums are described, and the factors influencing the selection of one of these types for a given application are discussed. The feasibility of applying photo-etching techniques to preformed shapes is demonstrated in the fabrication of etched-tube switching drums. The relative advantages and disadvantages of disks versus drums for switching applications are also pointed out. (auth)

322 SCTM-170-55(55)
Sandia Corp., Albuquerque, N. Mex.
SELF-LIMITING CHARGER FOR NICKEL–CADMIUM BATTERIES. E. B. Pearson. Aug. 11, 1955. Changed from OFFICIAL USE ONLY Oct. 21, 1959. 7p. OTS.

The development of a self-limiting charger for cadmium–nickel batteries is summarized. (auth)

323 SCTM-172-55(53)
Sandia Corp., Albuquerque, N. Mex.
AUTOMATIC TEST EQUIPMENT USED IN TESTING THERMAL BATTERIES IN THE NONACTIVATED STATE. Frederick H. Darugh. Aug. 17, 1955. Changed from OFFICIAL USE ONLY Oct. 21, 1959. 22p. OTS.

An automatic tester used for testing thermal batteries in the nonactivated state is described. The tester evaluates the ability of thermal batteries to withstand breakdown voltages. It also measures insulation resistance and electric squib resistance and determines the polarity of cold voltage outputs. (auth)

324 UCRL-5605
California. Univ., Livermore. Lawrence Radiation Lab.
AN IMPROVED GAMMA DETECTOR USING GAMMA MODERATION. Raymond Fox. Sept. 3, 1959. 17p. Contract W-7405-eng-48. OTS.

Theoretical and experimental results of the effect of gamma moderation are described. A 6.7-fold enhancement factor was obtained with a $\frac{1}{8}$-in.-thick sodium-iodide crystal when using gamma moderation and a Co^{60} gamma source. A counter was designed and built to make the most use of gamma moderation. The results indicate that this counter can be made energy independent over a wide region. Though the cost of the counter is about $\frac{1}{3}$ that of a 1-in.-diam., 1-in.-thick sodium-iodide crystal plus photomultiplier, the counting efficiency for gammas such as Na^{24} is over two times greater. (auth)

325 WADC-TR-54-409(Pt. III)
Oklahoma Agricultural and Mechanical Coll., Stillwater. Inst. of Tech.
UNCONVENTIONAL ELECTRICAL POWER SOURCES. Paul A. McCollum. Sept. 1956. 111p. Project No. 6058. Contract AF33(616)-2237. (PB-151726). OTS.

Research directed toward gaining additional information concerning the theoretical and practical limitations and capabilities of generating electrical power by means other than rotating machinery and conventional batteries is described. Data and theory are presented on the oscillating generator utilizing permanent magnet excitation, the variable reluctance oscillating generator, metal thermopiles, semiconductor thermopiles, thin film thermopiles, the fuel cell, p-n junction silicon solar cell, and nuclear converters. Results of laboratory experiments are presented on the permanent magnet oscillating generator, the variable reluctance generator, metal thermopiles, and the silicon solar cell. Efficiency of energy conversion, weight and size per unit power output, range of voltage and current, life and reliability were emphasized. (auth)

326 WCAP-6022
Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.
NUCLEAR MATERIALS CONTROL SYSTEM (NMCS). PHASE II. ALARM TRANSMITTING SYSTEMS AND THE PROTECTION OF COMMUNICATIONS. J. N. Ellyson and G. Kivenson. Oct. 1, 1959. 68p. Contract AT(30-1)-2176, Task I. OTS.

The application of a Nuclear Materials Control System (NMCS) to a nuclear complex requires protected communications systems for the efficient and secure transfer of many types of information. The distances involved may range from a few feet to several hundred miles. Many of the requirements can be met by techniques well known to government agencies and the military (e.g., crytographic systems). Most alarm transmission systems are intimately connected with the operation of a specific protection device. Therefore, the work planned by the NMCS Project in the field of communication security and alarm transmission was limited to: A study of techniques and apparatus for generating identification and security condition signals, in certain geographical areas; A special coding system for use in security condition reporting; Evaluation of a commercial system for the protection of wire transmission links; Methods of speech scrambling; Special short-range alarm transmission systems. The premature termination of all NMCS security devices studies prevented the accumulation of any significant

experience with any of the items listed above. Descriptions and discussions of the equipment and methods involved in items 2 through 5 are presented in Part A of this report. Parts B, C, and D of this report (together with a delivered prototype apparatus) represent the work performed on item 1 by the (Baltimore) Electronics Division of Westinghouse Electric Corporation under sub-contract to the NMCS Project. Some preliminary operational checks made on the equipment indicated more than adequate performance. It was concluded, on the basis of a limited amount of information, that the Electronics Division equipment would make an excellent system for its intended use; the commercial wire communication protection equipment investigated was found to be of equally high quality. (auth)

327   WCAP-6023
Westinghouse Electric Corp. Atomic Power Dept.,
    Pittsburgh.
NUCLEAR MATERIALS CONTROL SYSTEM (NMCS).
PHASE II. MISCELLANEOUS DEVICES FOR PLANT
SECURITY. G. Kivenson and J. N Ellyson. Oct. 1,
1959. 23p. Contract AT(30-1)-2176, Task I. OTS.

To fill the need for auxiliary protective equipment to be used for a Nuclear Materials Control System (NMCS) in moderately sensitive areas, an inquiry was made into the availability of small, relatively inexpensive devices having a wide range of applications. These units included vibration alarms, power line monitors, and mechanical disturbance indicators. Equipment for detecting pneumatic line failure and unauthorized valve operation was also evaluated. Some commercially-available equipment was found to be adaptable for these purposes. It was necessary, however, to design a number of new devices for certain specific applications. The successful use of a large number of protective devices simultaneously depends on the proper integration of the alarm data at the guard control post. Special panel boards have been considered for this purpose. (auth)

328   WCAP-6024
Westinghouse Electric Corp. Atomic Power Dept.,
    Pittsburgh.
NUCLEAR MATERIALS CONTROL SYSTEM (NMCS).
PHASE II. MISCELLANEOUS DEVICES FOR SAFE-
GUARDING A FUEL REPROCESSING PLANT. W. E.
Foster. Oct. 1, 1959. 22p. Contract AT(30-1)-2176,
Task I. OTS.

Various anti-syphon devices, a temperature recorder, and a device to assure a constant rate of air flow in pneumatic instrument lines were evaluated for possible inclusion in a Nuclear Materials Control System (NMCS). The devices are intended for use in a fuels reprocessing plant as supplementary equipment for the prevention of unauthorized diversion of source and special (SS) material. The plant is assumed to be under stringent inventory control conditions. The design and application of each device is enumerated. Sufficiently detailed specifications are provided so that the equipment can be independently duplicated. Recommendations concerned with the application of the devices to a fuels reprocessing plant are presented. (auth)

329   WCAP-6025
Westinghouse Electric Corp. Atomic Power Dept.,
    Pittsburgh.
NUCLEAR MATERIALS CONTROL SYSTEM (NMCS).
PHASE II. LIQUID SAMPLERS FOR SAFEGUARDS
USE. W. E. Foster. Oct. 1, 1959. 13p. Contract
AT(30-1)-2176. OTS.

Systems designed to obtain representative samples from various points in nuclear fuels reprocessing plants have been evaluated. From these sampler systems, two designs were chosen for use in a Nuclear Materials Control System (NMCS). For radioactive samplers coming from feed tanks and waste hold-up tanks, the Thorex sampler was chosen. For samples coming from the product end of the plant, the Savannah River vacuum sampler system was specified. Pertinent features concerning these sampler systems are described in the report, together with specifications for tamper-resistant features. Samples from the feed tanks and the waste hold tanks are inherently tamper-resistant because of their high radioactivity. The specified accountability points are considered to be sufficient for reasonable safeguarding of nuclear materials in a chemical processing plant. In a disarmament situation, more accountability points would be added to those indicated in this report. (auth)

330   WCAP-6026
Westinghouse Electric Corp. Atomic Power Dept.,
    Pittsburgh.
NUCLEAR MATERIALS CONTROL SYSTEM. PHASE
II. RECORDING WATTMETERS FOR SAFEGUARDS
USE. R. E. Kronk. Oct. 1, 1959. 19p. Contract
AT(30-1)-2176. OTS.

The recommended Nuclear Materials Control System (NMCS) includes equipment for monitoring the electrical power produced by a nuclear power station, as well as the power used by heavy equipment cranes. This report describes a design and development effort which was prematurely concluded with the selection of certain commercial wattmeters for evaluation as NMCS monitors. Tamper-resistant features for these wattmeters and recommendations for future work are discussed. (auth)

331   WCAP-6027
Westinghouse Electric Corp. Atomic Power Dept.,
    Pittsburgh.
NUCLEAR MATERIALS CONTROL SYSTEM (NMCS).
PHASE II. NEUTRON FLUX MONITORS FOR SAFE-
GUARDS USE. R. E. Kronk. Oct. 1, 1959. 23p. Con-
tract AT(30-1)-2176. OTS.

The over-all objective of the Nuclear Studies portion of the Nuclear Materials Control System (NMCS) program is to predict, by computation and measurement, the fissile material inventory at a nuclear reactor site. This report is concerned with the design of NMCS neutron monitoring instrumentation, and with some of the related technical difficulties in the application of these devices to fissile material control. Two instrument systems are described which supply potentiometer recorded and digital printed outputs corresponding to the monitored neutron flux. Detailed specifications for each of these instrument systems are given in the Appendix. (auth)

332   WCAP-6028
Westinghouse Electric Corp. Atomic Power Dept.,
    Pittsburgh.
NUCLEAR MATERIALS CONTROL SYSTEM (NMCS).
PHASE II. A THERMAL POWER METER FOR SAFE-
GUARDS USE. C. C. Webster. Oct. 1, 1959. 15p.
Contract AT(30-1)-2176, Task I. OTS.

The proposed Nuclear Materials Control System (NMCS) requires an accurate knowledge of the net quantities of fissile materials discharged from a reactor. A thermal power meter located in the primary coolant lines of both power reactors and large test reactors is

the most reliable method currently available for measuring the thermal power output of such reactors. This proposed design consists of a flow measuring device, combined with platinum resistance thermometers for measuring the temperature difference across the reactor or its associated steam generator. Tamper-resistant features are specified in order to assure the integrity of the measurements. (auth)

333   WCAP-6029
Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.
NUCLEAR MATERIALS CONTROL SYSTEM. PHASE II. GENERAL ACTIVITY DETECTORS FOR SAFEGUARDS USE. F. J. Arsenault. Oct. 1, 1959. 14p. Contract AT(30-1)-2176, Task I. OTS.

The application of radioactivity monitors to the detection of SS material diversion is discussed. Slug counters on the dissolver slug chutes at chemical processing plants are currently in use and appear practical. Pipeline monitors, area monitors, and portable monitors to survey areas, personnel, and vehicles are considered. (auth)

334   WCAP-6030
Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.
NUCLEAR MATERIALS CONTROL SYSTEM (NMCS). PHASE II. A GAMMA-RAY SCANNER FOR SAFE-GUARDS USE. C. C. Webster. Oct. 30, 1959. 28p. Contract AT(30-1)-2176, Task I. OTS.

A gamma-ray scanner can be used to identify irradiated power reactor fuel assemblies by studying their gamma activity, under thirty or more feet of water, with a shielded scintillation detector. Several AEC-supported laboratories have investigated and used similar methods to map the thermal neutron flux in a reactor and to predict the burn-up of fuel elements. The experimental results described show the principles of such a measurement. A scanner has been designed for use in a Nuclear Materials Control System (NMCS). The device is designed to accommodate fuel configurations ranging in size from a Yankee Power Reactor assembly down to an MTR element, by interchanging an adapter. Basically, the device consists of an arrangement for holding and rotating the fuel assembly, and a shielded movable scintillation detector. The design includes a suitable motion and position control system, and the nuclear instrumentation required to make the specified measurements. The estimated cost of the device including controls and instrumentation is about $20,000. The scanner was designed for use in a spent fuel storage pit. The materials of construction were chosen to minimize contamination of the water in the storage basin. The nuclear instrumentation, the electrical control unit, and the drive motors would be located at the edge of the pit. The electrical control unit regulates all the motions of the scanner and is fail-safe. A mock-up of the electrical control system was fabricated and tested. The nuclear instrumentation system also was assembled and tested. The nuclear instruments included a specially designed transistorized pre-amplifier which was built and evaluated. The scanner will fulfill the NMCS requirements for identification of spent fuel elements before and after shipment. The device can also be used to assist in allocating the calculated fissile material content of spent reactor cores to individual fuel assemblies. A feasibility study on the use of the device to determine the absolute fissile material content of spent power reactor fuel assemblies

indicates little promise of success. Eighty-eight detailed fabrication drawings of the gamma-ray scanner have been prepared, and are available upon request. (auth)

335   AEC-tr-3829
AN APPARATUS FOR CALIBRATION OF TUNGSTEN-MOLYBDENUM THERMOCOUPLES. S. K. Danishevskii (Danishevsky). Translated for Atomics International from Zavodskaya Lab. 22, 1235-40(1956). 19p. (Original, 6p.). JCL or LC.

An apparatus was built and a method was developed for the calibration of W-Mo thermocouples. A diagram of the apparatus is shown. (W.L.H.)

336   AEC-tr-3860
COUNTING OF FISSION FRAGMENTS AND HEAVY CHARGED PARTICLES BY MEANS OF THIN SCINTIL-LATION FILMS. V. M. Gorbachev and M. I. Kazarinova. Translated by Lydia Venters (Argonne National Lab.) from Pribory i Tekh. Ekspt., No. 4, 20-4(1957). 13p. JCL or LC.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 10837.

337   AERE-Trans-833
THE VIBRATION-INERTIA MILL. S. M. Dal'nov. Translated by J. B. Sykes (U.K.A.E.A. Atomic Energy Research Establishment) from Vestnik Akad. Nauk Kazakh. S.S.R., 14, No. 12, 71-5(1958). 7p.

A vibration-inertia mill is designed for the purpose of mechanical grinding of ore by means of vibration in order to isolate the minerals without overgrinding. (J.E.D.)

338   AERE-Trans-837
A METHOD FOR THE MEASUREMENT OF THE FLOW RATE OF GASES INDEPENDENT OF THEIR DENSITY AND VISCOSITY. Johannes Krutzsch. Translated by R. Todd (U.K.A.E.A. Atomic Energy Research Establishment) from Chemiker-Z. 82, 836-8(1958). 7p.

A brief survey of the methods for the measurement o. the flow rates of gases is presented. A method and related apparatus having a large range of measurement independent of the density, viscosity, and composition of the gas or gaseous mixture are described. (J.E.D.)

339   CEA-tr-A-517
POMPES CENTRIFUGES A HAUTES PRESSIONS, A UN SEUL ETAGE. (High Pressure Centrifugal Pumps with a Single Stage). R. Roosen. Translated into French from VDI Zeitschrift 101, No. 2, 63-7(1959). 17p.

Development is described of single-stage centrifugal pumps for high-pressure use, with turning housings for low flow rates and fixed housings for high. A pump is described, and results of comparison to piston pumps and multi-stage centrifugal pumps are given. (T.R.H.)

340   CEA-tr-R-662
ANALYSEUR D'AMPLITUDE A TUBE CATHODIQUE. (Cathode Tube Amplitude Analyzer). A. P. Tsitovich. Translated into French by M. Lagoustine and B. Vinogradoff from Pribory i Tekh. Ekspt., No. 4, 40-50(1958). 34p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 3789.

341
IONIZATION MEASUREMENTS IN PHOTOGRAPHIC EMULSIONS. Marietta Blau (Univ. of Miami, Fla.). Acta Phys. Austriaca 12, 336-55(1959). (In German)

To obtain statistically valid results from ionization measurements in photographic emulsions, it is necessary to establish the technique so that it gives quantitative results which are independent of deviations in the sensitivity of the emulsions and in methods of development. The problem consists of finding suitable parameters which represent the blackening state from point series as a function of the energy loss of the particles producing tracks. In a discussion of the problem, the grain density and specific energy loss, ionization parameters in emulsions, and model representation of the occurrence of point series are considered. An analysis of the results of experimental investigations leads to expressions describing the relationship between auxiliary parameters and to the determination of the grain density in the tracks. (J.S.R.)

342

A TIME-OF-FLIGHT SERIES AMPLIFIER FOR NUCLEAR PHYSICS COINCIDENCE MEASUREMENTS. Wolfgang Schneider (Universität, Vienna). Acta Phys. Austriaca 12, 453-60(1959). (In German)

A time-of-flight series amplifier, which uses the E180F broad band pentode was constructed. The suitability of this pentode for the amplifier is discussed, and the circuitry of the amplifier is described and schematically presented. The performance is briefly discussed. (J.S.R.)

343

EFFICIENCY, STABILITY, AND CHARACTERISTICS OF PHOTOSENSITIVE G. M. COUNTERS. Kazimierz W. Ostrowski (Academy of Mining and Metallurgy, Krakow). Acta Phys. Polon. 18, 231-53(1959).

Photosensitive counters used in direct reading spectrometry were investigated. Stable photosensitive counters constructed from metal with a cathode in the form of a strip set into the counter tube are described. The method used to measure the photoelectric efficiency is based on the known spectral distribution of an ultraviolet standard and the transmission of a UCΠ22 spectrograph. Counters with a platinum cathode proved to be the most stable. The variation of the photoelectric efficiency of G−M counters was investigated. Types of changes discussed include initial changes leading to a stable photoelectric threshold and a stable photoelectric efficiency, changes in efficiency of short duration observed above a certain counting rate, and charges in the photoelectric efficiency connected with the aging of the counter. A relation between the slope of the characteristics for ultraviolet radiation and the photoelectric efficiency was found. Slopes at 5 to 55%/100 v correspond to efficiencies between 10^{-3} and 10^{-10}. (auth)

344

MODIFIED FLAME PHOTOMETER FOR MICRODETERMINATION OF SODIUM AND POTASSIUM. A. K. Soloman and David C. Caton (Harvard Medical School, Boston). Anal. Chem. 27, 1849-50(1955) Nov.

A Beckman DU flame photometer was modified to determine micro amounts of Na and K in studies of perfusion of single kidney tubules in Necturus in vivo. Use of an RCA 6217 photomultiplier makes it possible to measure both Na and K with a single detector using 589 mμ and 768 mμ, respectively. Details of the modification and results obtained are given. (T.R.H.)

345

INTEGRATING MONITOR FOR DETECTING LOW CONCENTRATIONS OF GASEOUS BORON HYDRIDES IN AIR. Geraldine R. Fristrom, Lowell Bennett, and Walter G. Berl (Johns Hopkins Univ., Silver Spring, Md.). Anal. Chem. 31, 1696-7(1959) Oct.

An instrument is described that permits measurement of boron content in atmospheres containing small concentrations of volatile boron compounds. It is based on a quantitative conversion of boron to boric oxide with subsequent colorimetric determination. Its principal use is in the detection of low concentrations of toxic materials. (auth)

346

THE STRUCTURE OF LIGHT CENTERS IN ACTIVATED ZINC SULFIDE PHOSPHORS. N. Riehl and H. Ortmann (Technische Hochschule und Liebenwalde, Munich and Deutschen Akademie der Wissenschaften, Munich). Ann. Physik 4, 3-14(1959). (In German)

The transformation of blue luminescent Cu centers into green luminescent centers (and the reverse transformation) was studied. It is shown that the transformation can occur at 200°C with easily observable velocity. The transformation leads to the standardization of a fixed equilibrium ratio, characteristic for each temperature, for the concentration of the green luminescent centers up to that of the blue luminescent centers. In the temperature range from 20 to 300°C the equilibrium is displaced with increasing temperature in favor of the green luminescent centers. (Reagents capable of desulfurizing the surface of the crystal work in the same direction.) Sufficiently rapid cooling back to room temperature can freeze an equilibrium characteristic for a higher temperature. The reverse transformation green → blue occurs even at room temperature with a finite observable velocity. From this and from the highest value found for the activation energy it is seen that the green → blue transformation is bound to no incorporation or exhaustion of S^{2-} or Cl^- ions. It can be treated only as a diffusion of Cu^+ or Zn^{2+} ions in the interstices. As a model proposal for the blue luminescent Cu centers it is shown that there is a Cu^+ ion in the interstices in addition to a Cu^+ ion on a lattice position. (tr-auth)

347

FOURIER ANALYSIS OF THE ELECTRIC MICROFIELD IN A PLASMA. [PART] I. G. Hettner and H. Wagner (Technische Hochschule, Munich). Ann. Physik 4, 89-95(1959). (In German)

A Fourier analysis of the transient behavior of an arbitrary component of the electric field strength within a plasma was made. Probability statements on the sum of the Fourier amplitude can be made for an arbitrary but finite time interval, that is, a Gaussian distribution is given for it. The most probable frequency spectrum was obtained. From the interaction of the charged particles of the plasma it is seen what is permitted in not too great a density of these particles. (tr-auth)

348

VOLTAGE BREAKDOWN IN FAST SPARKS. E. Rose (Institut für Theoretische Physik, Bonn). Ann. Physik 4, 15-35(1959). (In German)

The statistical scattering and breakdown time of fast sparks was investigated in overvoltage. By means of a suitable circuit, up to 260% overvoltage can be applied to a spark gap. The overvoltage pulse has no directional front, but increases continuously during the spark channel buildup. Consequently, the distribution curve of the spark scattering has a maximum. This relationship

is derived theoretically and is in agreement with the results of previous workers. In the overvoltage applied, the buildup of the thermal spark plasma occurs in less than 0.2 nsec. The breakdown time is approximately 0.5 nsec. (tr–auth)

349

HEAVY-LIQUID BUBBLE CHAMBERS. Robert W. Williams (McGill Univ., Montreal). Can. J. Phys. 37, 1085–99(1959) Oct.

Experience with some high-Z liquids of fluid mixtures in bubble chambers, at M.I.T. and from other groups, is discussed. Measurement procedures are analyzed, and optimum methods are presented for angle measurements, $p\beta c$ determination from multiple scattering, and momentum determination from magnetic curvature. Magnetic fields are found useful even in strongly scattering liquids. Combined use of magnetic and scattering determination was found to be not much better than one alone. Results are presented on detection efficiency for high-energy gamma rays, and on the severe effects of radiation straggling on energy measurements on electron pairs. (auth)

350

NET POSITIVE SUCTION HEAD. Allen F. Sherzer (Sherzer Pumps, Ann Arbor, Mich.). Chem. Eng. Progr. 55, No. 9, 79–84(1959) Sept.

The operation of a centrifugal pump on the inlet or suction side is discussed relative to net positive suction head (NPSH) available and required. Tests results are presented from which the amount of NPSH that must be available in a pump installation to permit satisfactory operation at a specified rate of flow can be obtained. A test procedure is given to determine the additional amount of positive head needed where very hot or very volatile liquids are pumped and the vapor pressures of the liquid and of the atmosphere are close together. (C.J.G.)

351

NUCLEAR THERMAL PULSE SIMULATOR. D. J. Baker and D. E. Thomas (Air Force Cambridge Research Center, Bedford, Mass.). Electronics 32, No. 44, 66; 68–9(1959) Oct. 30.

Thermal detection systems are used to obtain quantitative measurements of thermal irradiances from nuclear detonations. For operational tests and calibrations of such systems, a nuclear thermal pulse simulator was developed. In the pulse simulator, xenon discharge tubes simulate the thermal source. Two capacitor discharge circuits are used to simulate the two peaks found in nuclear detonations. The trigger coil is a small transformer having a high turn ratio. A 0.25-μf capacitor at 150 to 300 volts is discharged through the coil primary to establish the flash tube ionizing grid pulse. Positive control with either manual or electrical triggering was effected with a cold–cathode thyratron. (C.J.G.)

352

A NON OVERLOAD LINEAR AMPLIFIER FOR SCINTILLATION AND PROPORTIONAL COUNTERS. C. Cottini, E. Gatti, and E. Zaglio (CISE, Milan). Energia nucleare (Milan) 6, 588–94(1959) Sept.

A high accuracy non-overload amplifier particularly suited to gamma-ray spectroscopy is described. Very high counting rates are allowed without distortion of the spectra. (auth)

353

A "SAMPLING OSCILLOGRAPH" FOR 4×10^{-10} SEC TIME RESOLUTION. H. P. Schlaeppi and H. P. Louis (IBM Forschungslaboratorium, Adliswil-Zürich). Helv. Phys. Acta 32, 328–31(1959). (In German)

An improved wiring diagram for a sampling oscillograph which allowed a time resolution of 4×10^{-10} sec is described. A block model of the oscillograph and a circuit of the coaxial network are given. (J.S.R.)

354

IMPROVEMENT OF THE PLATEAU OF G–M COUNTERS FILLED WITH ARGON–ALCOHOL MIXTURE. J. Kern and O. Huber (Institut de Physique de l'Université, Freiburg i. B.). Helv. Phys. Acta 32, 332–8(1959). (In German)

A systematic study was made of counters with a guard electrode to determine the factors affecting the slope and length of the plateau. The anode length, anode diameter, interior insulation, and the ratio R = 1000 V_g / V (where V_g is the voltage of the guard electrode and V is the voltage of the anode with the cathode voltage as reference) were investigated. The results of the study permitted the construction of a counter with a slope of 0.5% per 100 v and a plateau of approximately 150 v. (J.S.R.)

355

STAINLESS LANDS NUCLEAR JOB. PROVIDES PROTECTIVE SHELL FOR NONTOXIC BATTERY. Iron Age 184, No. 16, 109(1959) Oct. 15.

The advantages of stainless steel type 402 in a nuclear battery containing krypton-85 at 140 psig are discussed. (C.J.G.)

356

IONIZATION CAMERA FOR ABSOLUTE MEASURING OF THE ACTIVITY OF RADIOACTIVE PREPARATIONS. F. M. Karavayev. Izmeritel'naya Tekh. No. 5, 60–2(1959).

The absolute measurement of a γ-emitting substance can be done with a special ionization camera. It is a small camera and for this reason it can be used only to measure sufficiently strong preparations. The theory and calculation of the camera are shown. A spherical ionization camera has been constructed which consists of two concentric aluminum balls. Each one of them consists of two hemispheres. The inner radii are 130 and 150 mm. The walls are 4.99 mm thick, and the clearance between the balls is 10 mm. While measuring active preparations from 0.1 mc to 2 c, the ionization current runs from 10^{-13} to 10^{-6} a. The measuring accuracy for the ionization current is 0.5%. Excluding all systematic errors, a maximum error of 7 to 10% can be attained. An example is calculated. (TCO)

357

A DECATRON SCALER WITH PRELIMINARY SETTING OF THE COUNTING TIME OR PULSE NUMBER. I. Ya. Breydo. Izmeritel'naya Tekh. No. 7, 32–4(1959).

A description of a decatron scaler containing a unit for preliminary setting the counting time or a given number of pulses is presented. The block diagram of the device is shown. It will count pulses during an arbitrarily fixed time with manual start and stopping, count pulses with automatic stopping after a given time has elapsed, and measure the duration of recording with automatic stopping when the given number of pulses has been stored. The principal operational circuit elements of the device are shown. (TCO)

358

HEAVY IONS FROM A RADIO-FREQUENCY PROTON SOURCE. Finn Grønlund and Walter J. Moore (Indiana Univ., Bloomington). J. Chem. Phys. 31, 1132-3(1959) Oct.

The composition of a beam from an F-F source was investigated. The beam contains, in addition to H^+, H_2^+, and H_3^+, an ion identified as H_3O^+. For this reason it is hardly possible to obtain a reliable sputtering coefficient for neutral H, H_2, or He by this method. An analyzed beam of neutrals may be produced by neutralization of the analyzed ion beam. (J.R.D.)

359

TRITIUM-LABELED COMPOUNDS. I. RADIOASSAY OF TRITIUM-LABELED COMPOUNDS IN "INFINITELY THICK" FILMS WITH A WINDOWLESS, GAS-FLOW, PROPORTIONAL COUNTER. Horace S. Isbell, Harriet L. Frush, and Ruth A. Peterson. J. Research Natl. Bur. Standards 63A, 171-5(1959) Sept.-Oct.

A simple, sensitive, and reliable technique was devised for the radioassay of nonvolatile, water-soluble tritium compounds. The substance to be analyzed is dissolved in an aqueous solution of a thickening agent, preferably sodium O-(carboxymethyl) cellulose or sodium alginate. The solution is placed in a shallow planchet, and after evaporation of the water, the resulting film, which is "infinitely thick" to tritium beta particles, is counted with a 2π, windowless, gas-flow, proportional counter. By means of an empirical factor, determined with a substance of known radioactivity, the counts are converted to microcuries. In a film having a thickness of 0.7 mg/cm^2, the counting efficiency is about 4 percent; the standard deviation from the mean, obtained in a series of routine measurements, was less than 2 percent. An assay can readily be made with tritium-containing material having 0.01 microcurie of radioactivity. The method, which is applicable to nonvolatile, water-soluble solids, solutions, or liquids, is suitable for routine analyses. (auth)

360

IONIZATION CHAMBERS FOR THERMAL NEUTRON DOSE MEASUREMENT. F. Běhounek, J. Holanová, and J. Matoušková. Jaderná energie 5, 266-7(1959). (In Czech.)

The design of sensitive neutron ionization chambers is described. The calibration curve of these chambers was also determined. (auth)

361

REPORT ON HIGH-SPEED PHOTOGRAPHY. A. Folkierski (Imperial Coll. of Science and Tech., London). Nuclear Instr. and Methods 4, 346-51(1959) June.

The application of Kerr cells, image converters, rotating mirror cameras, and drum cameras to the photography of fast electrical discharges is critically discussed. The performance of representative examples of each of these technqiues is given quantitatively. (auth)

362

HIGH MAGNETIC FIELDS. Seth Berglund (Inst. of Physics, Uppsala). Nuclear Instr. and Methods 4, 386-90(1959) June.

The design and construction of coils producing high magnetic fields ($\leq$ 100,000 gauss) for plasma discharge devices are discussed. (C.J.G.)

363

ON SOME PROPERTIES OF THE RADIO FREQUENCY

ION SOURCE WITH LONGITUDINAL MAGNETIC FIELD. V. J. Kowalewski, C. A. Mayans, and M. Hammerschlag (Comisión Nacional de Energía Atómica, Buenos Aires). Nuclear Instr. and Methods 5, 90-4(1959) Aug.

A description is given of a radiofrequency ion source of the Thoneman type, but with a coaxial magnetic field. It is shown that with proper choice of the measured variables, simple straight line plots are obtained which can be given easy interpretation and be useful in further developments. Some limitations of this type of source are also shown. (auth)

364

NOTES ON THE DESIGN OF GLOW DISCHARGE VOLTAGE STABILIZERS FOR PHOTOMULTIPLIER TUBE POWER SUPPLIES. Leland K. Neher (Los Alamos Scientific Lab., N. Mex.). Nuclear Instr. and Methods 5, 95-100(1959) Aug.

A series of high stability neon glow discharge tubes (OG3/85A2) was used to stabilize 1685 volts for the dynode resistance divider of a photomultiplier tube to an accuracy of ±0.2%. The limit of stability and the aging phenomena for the tube operating at reduced currents are discussed but not understood. (auth)

365

AUTOMATIZATION OF PHOTOMETRIC MEASUREMENTS IN NUCLEAR EMULSIONS. C. Castagnoli, M. Ferro-Luzzi, F. Lepri, and G. Pizzella (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Nuclear Instr. and Methods 5, 101-6(1959) Aug.

A device for the automatic focusing of tracks is described, based on an electromagnetic remote control objective. The measurement and recording of several parameters related to the track's ionization are automatized. Time-gain, objectivity, and greater precision are the main advantages of the system. (auth)

366

A PROPORTIONAL COUNTER FOR LOW LEVEL COUNTING WITH HIGH EFFICIENCY. HL. De Vries and M. Stuiver (Natuurkundig Laboratorium, Groningen, Netherlands) and I. Olsson (Fysiska Institutionen, Uppsala). Nuclear Instr. and Methods 5, 111-14(1959) Aug.

Two small nearly identical counters were built in C^{14} dating laboratories from essentially the same material. The counting space was lined with quartz covered with a conducting layer and enclosed in a copper cylinder at ground potential. The backgrounds were 1.33 and 0.9 cpm and total volumes were 0.55 l with efficient volumes of about 0.46 l. (auth)

367

AN ELECTRONIC COINCIDENCE-METHOD OF HIGH RESOLUTION. Jens Christiansen (Technische Hochschule, Brunswick). Nuclear Instr. and Methods 5, 115-19(1959) Aug.

An electronical coincidence-method is described, which has a time resolution of 7×10^{-12} sec with artificial pulses. The statistical error of the apparatus was calculated and its agreement with the experimental data is stated. The calibration was performed with a variable delay line and the linearity of the relation between pulse-height and time delay was proved within a range of 2×10^{-9} sec. (auth)

368

A LOGARITHMIC, CONSTANT PERCENT ERROR, PULSE HEIGHT ANALYZER. A. Alberigi-Quaranta,

C. Bernardini, C. Infante, and I. F. Quercia (Comitato Nazionale per le Ricerche Nucleari, Milan). Nuclear Instr. and Methods 5, 120-23(1959) Aug.

A single channel pulse-height analyzer with a dead time of about 0.15 μsec is described. The channel width is determined by the passive characteristics of a delay line and is a constant percentage of the discriminator setting. An important feature of the device is a paralysis circuit. Circuit diagrams and calibration curves are given. (auth)

369

MULTIRANGE DELAY LINE FOR APPLICATION IN BETA-GAMMA COINCIDENCE STUDIES. I. D. Du Plessis, P. W. De Lange, and W. Weidemann (National Physical Research Lab., Pretoria). Nuclear Instr. and Methods 5, 127-8(1959) Aug.

The circuit of a counting signal delay unit with a range of 0 to 11.4 μsec in steps of 0.1 μsec is described. A continuously adjustable delay line (0.05 μsec per cm) covers a range of 1.5 μsec. The construction and design formulas of the latter delay line are given. (auth)

170

ELECTRONICS FOR RADIATION DETECTION. 2. DISCRIMINATOR AND ALLIED CIRCUITS. F. H. Wells (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Power 4, No. 42, 92-6(1959) Oct.

Some basic circuits for amplitude discriminators, including a cathode coupled univibrator, the d-c coupled trigger circuit with controlled paralysis time, circuits for dealing with very small and very fast input pulses, and a transistorized type for operating on current pulses are reviewed. It is shown how two amplitude discriminators followed by gating circuits are used to form a single channel pulse amplitude analyser and how refinements for stable narrow channel and accurate timing applications are made. After reviewing a Geiger Mueller quench circuit, a description of the principles of coincidence and anti-coincidence circuits as far as two channel slow circuits and a typical coincidence pulse shaping circuit and mixer are given. (auth)

371

PULSE TRANSFORMERS FOR COUNTING. A. L. Gray and R. Webster (Plessey Nucleonics, Ltd., Northampton, Eng.). Nuclear Power 4, No. 42, 106-9(1959) Oct.

A pulse transformer system for use with fission counters and BF_3 proportional counters, which permits operation over cable lengths of several hundred feet without loss of resolution, is described. The transformers use high frequency ferrite cores in the normal 25-mm pot core mounting. The preferred system of E. H. T. supply uses a second cable to avoid the bulk of the capacitor at the counter. (D.E.B.)

372

FISSION COUNTER SAMPLE DISK HOLDER AND SLIDE. C. L. Truman (Goodyear Atomic Corp., Portsmouth, Ohio). Nuclear Sci. and Eng. 6, 252-3 (1959) Sept.

The design of a fission counter which utilizes a hemispherical ionization chamber with which the sample disk mounting plate can form a gas-tight seal is given. Advantages in economy and operation of the mechanism over other counters are discussed. (C.J.G.)

373

A MULTI-PURPOSE 2π COUNTER. D. Prosperi and S. Sciuti (Comitato Nazionale per le Ricerche Nucleari,

[Rome] and Istituto Nazionale di Fisica Nucleare, Rome). Nuovo cimento (10) 13, 769-77(1959) Aug. 16.

A gas counter with a spherical symmetry is described. This detector can work in a very satisfactory manner, either as a flow counter or a ionization chamber reaching, in the latter case, a good α pulse-height resolution, even with large emitting sources. Calculations are made in order to find the dependence of the pulse shape on the direction of emission of an α-particle by a point source in the chamber (finite track). A good agreement is found between these calculations and the experimental tests performed, which show that this dependence can be employed in high efficiency measurements of angular α-γ correlations. (auth)

374

LUMINESCENCE YIELD OF CsI(Tl) CRYSTALS UNDER α AND γ EXCITATION AS A FUNCTION OF Tl CONCENTRATION. Yu. (Iu.) A. Tsirlin, S. N. Komnik, and L. M. Soifer. Optics and Spectroscopy (English Translation) 6, 265-6(1959) Mar.

The luminescence yield under α-bombardment has a well-defined limiting value, reached at Tl concentrations of 0.1%. Luminescence yield under γ bombardment has a maximum in the Tl concentration range 0.01 to 0.03%. The dependence of the ratio α/γ at room temperature tends to a constant value of ~0.55. The limiting value of the ratio is essentially attained at a Tl concentration of ~0.1%. (D.E.B.)

375

AUTOMATIC TREATMENT OF PARTICLE TRACK PHOTOGRAPHS IN BUBBLE CHAMBERS. B. N. Moiseev. Priroda 48, No. 5, 82-4(1959) May. (In Russian)

A scheme for automatic measurement and recording of charged particle tracks in bubble chambers by means of electronic computers is described. (R.V.J.)

376

TRAJECTORY PLOTTING IN ELECTRON GUNS. G. D. Archard (Associated Electrical Industries, Ltd., Research Lab., Aldermaston, Berks, Eng.). Proc. Phys. Soc. (London) 74, 177-82(1959) Aug.

A method of representing space charge on a resistance network analogue by means of leak resistances is described and applied to the determination of trajectories in several conventional and unconventional electron guns. (auth)

377

SOME RESULTS IN THE ELECTRON OPTICS OF BETA SPECTROSCOPES OF THE KOFOED-HANSEN TYPE. Carlos Alberto Mallmann (Comisión Nacional de Energía Atómica, Buenos Aires). Publs. com. nacl. energía atómica (Buenos Aires) Ser. fis. 1, No. 5, 93-99(1954). (In Spanish)

The theory of Kofoed-Hansen beta-ray spectrometers, in which the electrons describe n loops, is discussed. The motion of the electrons with respect to φ, is given in more detail than in a previous publication. (auth)

378

SIMULATION OF THE TRAJECTORIES OF RELATIVISTIC ELECTRONS IN A MAGNETIC UNDULATOR. A. N. Vystavkin, Yu. V. Anisimova, and S. S. Shakhidzhakov. Radiotekh. i Elektron. 4, 550-1(1959).

A magnetic undulator is described which consists of an electron gun, a mechanism for displacing the gun, a bellows, magnetic rails, a drift tube with hermetically sealed windows, a stationary collector electrode,

a device for imparting a motion in vacuum, and pole pieces for producing the magnetic field. (W.D.M.)

279

ELECTRO-MAGNETIC PUMPS FOR LIQUID METALS. L. R. Blake (United Kingdom Atomic Energy Authority, Caithness, Scotland). Reactor Technol. **1**, 65-76(1959) Aug.

As a guide to pump selection, about a dozen of the more important types of electro-magnetic pumps are described, including their principle of operation, field of application, and operating characteristics. Manufacturing problems are not discussed. (auth)

380

HIGH TEMPERATURE MODIFICATION OF THE BECKMAN DU SPECTROPHOTOMETER. Benson R. Sundheim and Jacob Greenberg (New York Univ.). Rev. Sci. Instr. **27**, 703-4(1956) Sept.

A modification of the DU spectrophotometer is described which is capable of observing absorption spectra of liquid systems up to 650°C. (auth)

381

NUCLEAR SCINTILLATION SPECTROMETRY AND THE RIDL 100-CHANNEL SELECTOR. Francesca de Michelis (Istituto di fisica sperimentale del Politecnico, Turin). Ricerca sci. **29**, 1691-5(1959) Aug.

A brief description of the various test apparatus of the Institute of Experimental Physics of the Turin Polytechnic School, which in their totality form equipment suitable to perform research work in nuclear spectroscopy. A prominent part of the equipment is the RIDL 3300 Type 100-channel selector, which has been working for a few months and has already been utilized in some research work. The possibilities and performance of this apparatus are especially described. (auth)

382

THE EMPLOYMENT OF ELECTRICAL VORTEX FIELDS IN ANALOG STUDIES OF TWO-DIMENSIONAL CIRCULATORY CURRENTS BY THE ELECTROHYDRO-DYNAMIC ANALOGY METHOD. G. A. Ryazanov. Trudy Leningrad. Inst. Inzhener. Vod. Transp. No. 23, 219-22(1956). (Translated from Referat. Zhur. Mekhan. No. 9, 1957, p.128).

A description is given of a system for analog studies of two-dimensional circulatory currents by the electrohydrodynamic analog method which differs essentially from the systems known heretofore. The novel system is based upon the utilization of the electrical induction field which surrounds every a-c electromagnet and produces Foucault currents in any conductor. The induction field is superimposed upon the electrical potential field, the latter being produced in the usual fashion. A general view of the apparatus is given, together with a brief description of the measuring techniques employed. The conducting medium consists of aluminum foil or low-resistance conductive paper. The measurements are performed with the aid of a vibration galvanometer of the VG-400 type.

383

METROLOGY OF PENETRATING RADIATIONS. K. K. Aglintsev, Z. P. Balon, B. S. Dzhelepov, F. M. Karavaev, P. T. Prokof'ev, S. A. Rusinova, O. I. ?, Sumbaev, Ye. A. Khol'nova, S. A. Shestopalova, M. F. Yudin, and I. A. Yaritsyna. Vsesoyuz. Atomnaya Energ. v Mirnykh Tselyakh. [Moscow], Gosenergoizdat. 145-181 (1957). (Translated from Referat. Zhur. Elektrotekhn. No. 3, 1959, p.135).

Investigations on the standardization of measurements in ionizing radiation and the construction of standard and reference apparatus for reproducing the fundamental units in the complete range of energy and intensity for all types of radiation are reported. A number of apparatus are described. Activity measurement methods by counting the number of particles emitted by a preparation are being developed. The methods used for the measurement of isotopic half life are described.

384

A NEW ELECTRODE SYSTEM FOR AN X-RAY TUBE WITH POINT FOCUS. Rolf Hosemann (Max-Planck-Gesellschaft, Berlin-Dahlem) and Johannes Hoeft (Freien Universität, Berlin-Dahlem). Z. angew. Phys. **11**, 365-7(1959) Sept. (In German)

A simple electrode system for the production of point focus down to 30μ half width is described. The electrode arrangement is characterized by a long-life cathode, a Pierce cathode system, and an intermediate electrode which operates as small positive initial voltage compared with the cathode. The electrons from the cathode (diameter approximately 2 mm) enter the field-free space within the intermediate cathode as an almost parallel electron beam and are focused just in front of the anticathode. (tr-auth)

385

MASS SPECTROGRAPHIC INVESTIGATIONS WITH THE HELP OF A FIELD EMISSION ION SOURCE. H. D. Beckey (Universität, Bonn). Z. Naturforsch. **14a**, 712-21(1959) Aug. (In German)

A field emission ion source, in which the diverging ion beam originating on a tungsten point in a field strength of 1 to 5×10^8 v/cm was focused on the inlet aperture of a mass spectrometer, was developed. The mass spectra observed are very simple in comparison to those which arise in the use of an electron-collision ion source. Ion reactions of molecules with paired and unpaired electrons in the field emission source, the association of molecules, and the formation of condensed layers on the emission point were investigated. Free radicals formed in chemisorption and photochemical reactions were detected. (tr-auth)

386

A THREE FILAMENT ASSEMBLY FOR A SOLID SOURCE MASS SPECTROMETER WITH ALTERNATELY HEATED SIDE FILAMENTS. J. Schutten (F.O.M.-Laboratorium voor Massaspectrografie, Amsterdam). Z. Naturforsch. **14a**, 764-5(1959) Aug.

A three-filament assembly for a solid ion source to be used in those cases where the isotopic ratio in standard and sample is approximately the same is described. The degree of contamination was tested. (J.S.R.)

387

SIMPLIFIED CONSTRUCTION OF A RADIOACTIVE RELAY. K. S. Klempner, V. A. Machkovskii, and Ye. S. Shlyakhovetskii. Zavodskaya Lab. **25**, 623-4 (1959).

The relay construction included a thyratron cell with a reaction threshold of 10 pulses/sec. A rectifier (connected by way of selenium poles) and the thyratron cell are present. The anode connection of the thyratron contains an electromagnetic relay. The high-tension rectifier can be grounded on the positive as well as the negative pole so that the tube can be connected in any way

desired. A variant of the scheme without transformer was also worked out. (TCO)

388

INSTABILITY OF ELECTRON CLOUD IN MAGNETRON. B. B. Kadomtsev. Zhur. Tekh. Fiz. 29, 833-44(1959) July. (In Russian)

It is shown that in the case of a field with larger than critical H, the electron cloud is unstable in a continuous magnetron with loop-like electron motion, and the increment rate of small perturbations in the steady state is identical to one order of magnitude of transit time. (tr-auth)

389

A VACUUM ADSORPTION PUMP. B. G. Lazarev and M. F. Fedorova (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Tekh. Fiz. 29, 862-5(1959) July. (In Russian)

Descriptions are given of a cooled carbon gas adsorption vacuum pump with a capacity of 30 1/sec and maximum vacuum $< 10^{-7}$ mm mercury. The efficiency curve based on pressure and liquid nitrogen consumption is plotted. (R.V.J.)

390

SONDERAUSSCHUSS RADIOAKTIVITÄT, KOLLOQUIUM ÜBER MESSMETHODEN, 1957. (Special Commission on Radioactivity. Colloquim on Methods of Measurement, 1957). No. 6 of "Schriftenreihe des Bundesministers für Atomkernenergie und Wasserwirtschaft. Strahlenschutz." Brunswick, Gersbach and Sohn Verlag GmbH, 1958. 170p. DM 4.

The proceedings of a conference on methods for the measurement of radioactivity in water, air, fall-out, soil, and plants are presented. The papers presented include: Natural Radioactivity in Air, Water, and Soil; Measurement of the Radioactivity in the Air by the Filter Method; Filter Properties with Respect to the Measurement of Natural and Artificial Radioactivity in Air; Electrostatic Precipitation for the Detection of Radioactive Aerosols; Measurement of the Radioactivity of Fall-out; Measurement of the Gamma Activity of Rain Water; Measurement of the Radioactivity of Dust and Dust Collecting Film; Measurement of the Radioactivity of Dust Sweepings for the Photochemical Industry; Measurement of the Radioactivity of River Water; Measurement of the Radioactivity of Drinking Water; Measurement of the Radioactivity of Plants and Food Substances; Method for Measurement of the Radioactivity of Dust; Measurement of the Radioactivity in Milk; Errors and Losses in the Vaporization of Water Samples; and Relative Calibration Methods in Fission Product Measurements. The discussions given on each paper are also presented. (J.S.R.)

391

IONIZATION MANOMETER. Manfred Motthias Dunkel. British Patent 816,901. July 22, 1959.

An ionization vacuum gage is described which offers ease and uniformity of manufacture and degassing by heating. The central straight collector wire is surrounded by a cylinder of spiral grid wires. This arrangement is enclosed in a circular wire cathode and a screening electrode. (T.R.H.)

392

A RADIOACTIVE RESISTANCE. N. I. Shteynbok. U.S.S.R. Patent 84628. Byull. Izobret., 1959, No. 5.

The radioactive resistance is made in the form of a gas-filled hermetically-sealed tube made of insulating material and containing two plane-parallel elec-

trodes one of which is covered with a layer of radioactive material, and has new features such as the opposing surfaces of both electrodes and the outer surface of the radioactive material are covered with gold or platinum and to restrain the emanations of radium in the radiator, the radioactive material is applied to a layer of activated carbon covering the gilt or platinized surface of the radiator. (TCO)

393

A SCINTILLATION GAMMA-SPECTROMETER. A. A. Ionov. U.S.S.R. Patent 115807. Byull. Izobret., 1958, No. 11.

A gamma-spectrometer with two photo-multipliers operating on one scintillating crystal, and a coincidence circuit was designed. To increase the discrimination capacity of the instrument, the photo-multipliers are connected to separate spectrometering devices connected by their outputs to the input of the coincidence circuit. (TCO)

394

A DEVICE FOR MEASUREMENT OF MAGNETIC FIELDS. A. Ya. Rotshteyn. U.S.S.R. Patent 117065. Byull. Izobret., 1959, No. 1.

A device consisting of two nuclear-resonance pickups, a switch, an amplifier, a detector, and a frequency meter is described. One of the two pickups contains an isotope with a positive magnetic moment, and the other with a negative, which excludes the measurement errors through the relative shift of the pickup from the vector of the magnetic field under investigation. (TCO)

395

A RADIOACTIVE IONIZATION MANOMETER. L. P. Khavkin. U.S.S.R. Patent 117142. Byull. Izobret., 1959, No. 1.

A manometer with a radioactive source placed inside its chamber is discussed. The secondary emission of the collector is eliminated by placing the radioactive material into a hollow in the end of the central rod and the ring collector around the central rod in such a way that it is inaccessible for the stream of particles. (TCO)

Materials Testing

396   AECU-4274

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

HANFORD EXPERIENCE IN THE NONDESTRUCTIVE TESTING OF NUCLEAR PROCESS VESSELS AND PROCESS PIPING. Richard B. Socky. Oct. 15, 1958. 69p. OTS.

Presented at the 1958 AEC Welding Committee Meeting at Hanford in October 1958.

The nondestructive testing of nuclear process vessels and process piping by x-ray, fluoroscopic, gamma-ray, ultrasonic, eddy current, borescope, leak detection, alloy identification, penetrant, magnetic particle, stress measurement, and hardness methods are presented. (W.L.H.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

397   NYO-2921

Columbia Univ., Palisades, N. Y. Lamont Geological Observatory.

GEOCHEMISTRY AND PHYSICS OF OCEAN CIRCULA-
TION. W. S. Broecker, R. D. Gerard, M. Ewing, and
B. C. Heezen. 1959?. 36p. Contract AT(30-1)-1808.
(CU-6-59-1808-Geol.). OTS.

The use of radioactive isotopes for determination of
oceanic mixing rates is examined. The main features
of the tracer method are illustrated by an analogy. Ex-
perimental procedure is outlined and a discussion of
results is presented. It is pointed out that great quan-
tities of data are needed and complete correlation of
these data with available oceanographic information is
required as a basis for useful circulation models. C^{14}
appears to be the most useful tracer. It is concluded
that isotope methods are best for large scale problems.
Mixing within given masses of water is in many cases
apparently too rapid to show appreciable concentration
differences. In this respect the method supplements the
deep float method which yields more detailed informa-
tion in local areas. Diagrams and charts are included.
(J.R.D.)

398   NYO-2922
Columbia Univ., Palisades, N. Y. Lamont Geological
   Observatory.
THERMOGRAD MEASUREMENTS IN WATER AND
SEDIMENTS OF THE DEEP SEA. Maurice Ewing,
R. D. Gerard, and M. Langseth. Sept. 1, 1959. 42p.
Contract AT(30-1)-1808. (CU-5-59-1808-Geol.). OTS.

An instrument for measurement of thermal gradients
in ocean bottom sediments was developed. Fourteen
measurements of thermal gradients were made in the
Atlantic Ocean with this instrument. Six measurements
were made in the Guiana Basin, three in the outer ridge
north of Puerto Rico, two in the Mid-Atlantic Ridge, and
single measurements in the Puerto Rican Trench, Car-
ibbean Sea, and the continental rise east of Cape Hat-
teras. The instrument is mounted directly on a piston
coring device. A sediment column is taken simultane-
ously with the thermal gradient measurement, and deep
penetration (10 meters and more) can be obtained in
most areas. The operation reliability of the piston
corer allows easy handling and assurance of vertical
penetration, with very little equipment loss. Thermistor
type temperature probes which come to thermal equi-
librium within a minute after penetration are used. Wa-
ter temperature is continuously recorded during lower-
ing and raising of the instrument, thus a detailed picture
of the temperature structure in the water column is ob-
tained. (auth)

399   SCR-118
Sandia Corp., Albuquerque, N. Mex.
ATMOSPHERIC TURBULENCE. Hans A. Panofsky.
Sept. 1959. 17p. OTS.

Some characteristics of turbulence near the ground
can begin to be interpreted. There is yet little informa-
tion about others (even near the ground) such as spec-
tra measured along the vertical lines, or cross spectra
between two variables. Further, results of turbulence
characteristics over water are few and confusing, and
no information exists about the effects of cities and
deserts. As we go aloft, our information about spectra
becomes more scanty, although the general areas of
large turbulence intensity are fairly well known. (auth)

400
THE PITCHBLENDE AND SULFIDE ORES OF RIO
FREDDO—PEVERAGNO. Felice Ippolito (Comitato
Nazionale per le Ricerche Nucleari, Rome). Boll. soc.
geol. ital. 63, 1-44(1954). (In Italian)

In the first part of this work, the geology and pe-
trology of the Mount Besimauda area (Eastern Maritime
Alps) are examined. The investigation includes grounds
from the Permian to the middle Trias; examined in de-
tail are the porphyric masses of the Permian and asso-
ciated tuffs, in which effectively pitchblende ore bodies
occur. In the second part, the ore is examined. The de-
posit has an hydrothermal origin, of upper Permian or
lower Triassic age; but the original character is not
definitely known, because the ore bodies within country
rocks were highly metamorphosed. The main metallic
minerals are: pitchblende, pyrite, chalcopyrite; the
gangue mineral is quartz. Also in the Rio Freddo mine
a red alteration has been recognized. This feature is
investigated frequently in all the world uraniferous de-
posits and it is named "hematite alteration"; it has
affected both gangue and wall rocks. The "hematite
alteration" at Rio Freddo may have been developed
also from the alteration of the primary pitchblende ore
bodies; the red supergene products such as gummite or
uranophane might have impregnated the gangue miner-
als and country rocks. In the last chapter, after a dis-
cussion on the origin of the hydrothermal solutions,
this deposit is compared with other already well known
deposits and concludes attributing the ore of Rio Freddo
to the "siliceous-pyrite-galena" ore type described by
Everhart & Wright. (auth)

401
LEAD ISOTOPIC RATIOS OF SEDIMENTARY URA-
NIUM DEPOSITS IN SWITZERLAND AND ITALY.
G. Ferrara (Comitato Nazionale per le Ricerche
Nucleari, Pisa, Italy), D. Ledent (Université Libre,
Brussels), and H. Stauffer (Physikalisches Institut der
Universität, Bern). Helv. Phys. Acta 32, 279-82(1959).
(In German)

The lead isotopic ratio of some uranium-bearing
mineralizations in the Italian and Swiss Alps and their
age were determined. The isotopic analysis was made
mass spectrographically and the results are tabulated.
The age determinations were made by the U^{238}/Pb^{206}
method, in which the U/Pb chemical ratio is determined
by the RaD method. The results are given. (J.S.R.)

402
INVESTIGATION OF THE ATTENUATION OF GAMMA-
RAYS PASSING THROUGH COAL. V. D. Goroshko.
Izvest. Akad. Nauk S.S.S.R. Otdel. Tekh. Nauk Met. i
Toplivo, No. 1, 120-2(1959).

The attenuation of gamma rays of various energies
passing through specially prepared coal/rock and
coal/pyrite briquettes was studied. The energy range
covered (with a suitable selection of radioactive iso-
topes) was 1.33 to 0.085 Mev. Preliminary calculations
of the effect were carried out making certain simplifica-
tions based on similarity of behavior of coal elements;
these become less valid at lower energies. Calculations
for 1.3, 0.66, 0.3, 0.018, and 0.06 Mev energies show
that difference in attenuation increases with decreasing
gamma-ray energy, increasing thickness of absorbing
layer, and increasing pyrite content. A great increase
in contrast is obtained with energies below 0.085 Mev.
The deviation of the experimental from the calculated
results is negligible with hard rays and gradually
increases as the energy decreases; for purposes of
coal testing for mineral content the deviations have
little effect. Values of experimental and calculated
contrast coefficients for rays of various energies pass-
ing through 10 cm thick coal/rock and coal/pyrite

briquettes are shown. Curves of the intensity change
of 0.085 Mev gamma rays passing through coal/rock
briquettes 25 to 140 mm thick are included. It is sug-
gested that the attenuation effect could be used for
automatic removal of rock or pyrites from a stream of
coal lumps or for automatic separation of run-of-mine
coal according to its mineral (particularly pyrite)
content. (TCO)

403

SOME EFFECTS OF PRESSURE ON THE THERMO-
LUMINESCENCE OF LIMESTONE. Ernest E. Angino
(Univ. of Kansas, Lawrence). J. Geophys. Research 64,
1638-40(1959) Oct.

Glow curves are presented which indicate that pres-
sure activates thermoluminescence in some limestones
and not in others. The reason for differences in pres-
sure activation was not established. However, the
length of time of pressure application appears to be a
more critical factor than the actual pressure applied.
(D.E.B.)

404

STUDIES ON THE LEAD ALPHA METHOD OF GEO-
CHRONOLOGY. V. S. Venkatasubramanian and V.
Sivavamakrishnan (Indian Inst. of Science, Bangalore).
J. Sci. Ind. Research. (India) 18B, 311-13(1959) Aug.

Lead alpha ages were determined for a number of
zircon and cyrtolite specimens. The experimental
methods are described and results discussed in terms
of available geochronological data. (auth)

405

ATMOSPHERIC DIFFUSION. A. S. Monin. Soviet
Phys.—Uspekhi 2, No. 1, 50-8(1959) Jan.-Feb.

A review is given on factors which effect atmospheric
diffusion. The characteristics of turbulent diffusion are
discussed and semi-empirical and statistical equations
are given for both large- and small-scale turbulent
diffusion. (C.J.G.)

406

THE GEOLOGICAL SIGNIFICANCE OF ISOTOPES.
A. S. Uklonskiĭ. Trudy Sredneaziat. Politekh. Inst.
(Tashkent), Gosizdat, Uzbek. S.S.R. 13-38(1955).
(Translated from Referat. Zhur. Geol. No. 1, 1957,
p.89-90).

The distribution of the chemical elements in the
geosphere in relation to their isotopic composition is
examined. All the elements are divided into 10 families,
depending on the number of isotopes. The sialic shell
of the earth is monoisotopic, and it is indistinctly
(except for Co and Rh) associated principally with acid
magma. V and Mn are associated both with acid and with
basic magma. Two extreme types of elements are dis-
tinguished in the di-isotopic group—one with a sharp
predominance of one isotope over another and one with
approximately uniform proportions of isotopes. H, C,
and N are elements of the biosphere. N also forms the
principal mass of the atmosphere, whereas Cl and Br
are associated with evaporites. Residual di-isotopes
(except for iridium) are also characteristic of the sialic
shell. Tri-isotopes include O, Si, U, K, and Mg. Si and
O are ubiquitous in the earth's crust. U and K are
characteristic of the sialic layer, Mg of the simatic
layer. Of the tetra-isotopes, Fe and Cr are simatic
(sic) elements; Ce, Rb, and Pb are simatic and S is
ubiquitous. Among the penta-isotopes, Zn, Ge, Zr, and
W are sialic, and Ti and Ni simatic. Only Pd of the
hexa-isotopes (Ca, Se, Kr, Pd. Er, Hf, and Pt) is

simatic. Of the hepta-isotopes (Mo, Ru, Ba, Nd, Gd,
Yb, Sm, Dy, Os, and Hg) Ru and Os are simatic; the
others belong to the sial. Two sialic elements are octa-
isotopic: Cd and Te. Only xenon has nine isotopes, and
only Sn has ten (a sialic element). A comparison of
the chemical compositions of the atmosphere and of
the earth indicates that the chemical elements that are
absent on the sun (these are chiefly mono-isotopic) are
young and that the geosphere is not all of the same age
(the sial is younger than the sima). A brief discussion
is given on the results of work to determine the total
isotopic composition of the waters in several regions
of Central Asia. The waters that were studied were
separated into three types: (1) light (from mountain
streams), approximately -3γ; (2) median (most rivers),
approximately $\pm 0\gamma$; and (3) heavy (waters of seas and
lakes, oil waters), from $+1\gamma$ to $+8\gamma$. Tables are given
to show the families of stable isotopes. (TCO)

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DEPOSITS OF URANIUM AND THORIUM. P. F. Kerr.
Vsesoyuz. Sbornik Atomnaya Syr'yevykh Materialov.
Moscow, Gosgeolotekhizdat, 119-219(1956). (Trans-
lated from Referat. Zhur. Geol. No. 4, 1957, p.126).

The present report on deposits of uranium and tho-
rium was presented in the name of the United Nations
at the Geneva conference on peaceful use of atomic en-
ergy. The first chapters are devoted to general infor-
mation on uranium and thorium and the deposits of
these elements. Much attention is devoted to the min-
eralogy of these elements and to the origin of the
deposits. The greater part of the report is given to
brief descriptions of deposits. The author groups
these as follows: (1) deposits formed from hot solu-
tions; (2) ancient uranium mineralization (veins);
(3) young uranium mineralization (veins); (4) uranium
in early sedimentary rocks; (5) separations of thorium
by direct crystallization; (6) concentrations of uranium
and thorium in normal sedimentary rocks. Descriptions
of deposits were assembled from reports presented at
the Geneva conference. (TCO)

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OKOLORUDNYYE IZMENENIYA BOKOVYKH POROD
KAK KRITERII PRI POISKAKH MESTOROZHDENIY
URANA. (Changes of Wall Rock as Indications of the
Presence of Uranium). P. F. Kerr. Moscow,
Gosgeoltekhizdat, 1956. 10p. (Translated from
Referat. Zhur. Geol. No. 4, 1957, p.163-4).

There is no significant difference between changes
in wall rock of uranium deposits and changes of wall
rock of deposits of other metals. Types of hydrothermal
change, probably associated with the process of depo-
sition of uranium, are enrichment in iron, fluoritization,
chloritization, argillization, alunitization, and delomiti-
zation. Hematitization which causes coloration of the
wall rocks, occurs in some deposits of the Canadian
Shield and in the Sunshine and Marysvale deposits in
the U.S.A. There are accumulations of siderite around
the uranium ores in Temple Mountain. Possibly Fe
was leached out of the sedimentary rocks below and was
redeposited in the form of siderite as the veins and as
dispersed material on the higher level. The presence
of fluorite in a number of deposits of the U.S.A. has
been confirmed; the presence of this mineral is often
considered to be an indication of the presence of ura-
nium. Argillization of the wall rock is associated with
uranium mineralization in the Marysvale deposit.
Radioactivity anomalies coincide with the areas of

development of argillized rocks. The basic uranium mineral in the Marysvale veins is pitchblende; a uranium-molybdenum mineral known as umohoite is found in one of the mines. Chloritization of biotite is observed at the first stage of alterations in the quartz monzonates of Marysvale. Montmorillonite and kaolinite are the basic argillaceous minerals of this deposit. Illite develops where the change is more advanced; sometimes fluorite develops at the latter stage also. Most of the pitchblende and pyrite was apparently formed at the end of the Argillite stage or even later. Argillization is also observed at some localities in the sedimentary rocks of the Colorado Plateau. Alunite is encountered in the walls of uranium deposits, but the relation between alunitization and mineralization is not clear. The basic stage of hydrothermal alunitization of Marysvale apparently preceded uranium mineralization. Alunite occurs around some deposits of the Colorado Plateau. Dolomitization of sandstones occurs in Temple Mountain, but it is not directly related to the deposition of uranium. The deposits of uranium were formed after dolomitization, since uranium-bearing asphaltite is encountered in veins intersecting the dolomite. There are many indications of quartzification in some sectors of uranium deposits; however, the effect of quartzification and its value as an indication of the presence of uranium have not yet been adequately studied. Changes of wall rock in the vicinity of the ore may prove to be useful criteria in prospecting for uranium. However, their usefulness will vary with the characteristics of the different areas. (TCO)

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A METHOD OF GAMMA-RAY LOGGING. A. A. Korzhev. U.S.S.R. Patent 73265. Byull. Izobret., 1959, No. 1.

A well logging method is described for determining the strata by comparison of two log diagrams: the first is obtained by measurement of the natural background of gamma radiation of a well irradiated by a source of neutrons and the second diagram is taken later. (TCO)

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A METHOD OF EXPLORING PERMEABLE ROCKS IN DRILL WELLS BY MEANS OF LOGGING BY THERMAL NEUTRONS. L. S. Polak. U.S.S.R. Patent 97494. Byull. Izobret., 1958, No. 11.

Design of an apparatus to evaluate the permeable strata in a well when the resistance of water saturating the stratum is near the resistance of clay liquid is described. The drilling is performed with the use of a clay liquid with an addition of boric acid. The zone of permeation is marked off by the minimum readings on the neutron-logging curve. (TCO)

411

A DEVICE FOR RADIOACTIVE CORE-SAMPLING OF BORES. Ya. Ya. Gorskii. U.S.S.R. Patent 118451. Byull. Izobret., 1959, No. 5.

The device registers the pulses of different polarity coming up the cable from two radioactive radiation pickups. A two-channel receiver with a preliminary amplification stage common to both channels is included along with a circuit for splitting the pulses into two channels, and a cascade for shaping and totaling the pulses. To exclude the influence in measurements of a cable parameter change and disappearance of pulses in one of the polarities, a paraphase amplifier is used from which the pulses pass to the two measuring channels and, through diodes, to the pulse amplitude

meter which generates the voltage of regulation and the amplification of the preliminary cascade. (TCO)

HEALTH AND SAFETY INCLUDING DOSIMETRY

412   AHSB-25
United Kingdom Atomic Energy Authority. Industrial
   Group H. Q., Risley, Lancs, England.
THE ESTIMATION OF AVERAGE GAMMA DOSE-RATES DUE TO ARGON-41 EFFLUENT FROM STAGE I REACTORS. J. R. Beattie. Aug. 10, 1959. 25p. BIS.

A short theoretical treatment is given from which the long term average gamma dose rates due to Ar^{41} effluent may be estimated. The theoretical results are compared with survey measurements in the vicinities of three reactor sites. (auth)

413   CF-59-6-39
Oak Ridge National Lab., Tenn.
RADIATION HAZARDS FROM RECYCLED REACTOR FUEL. E. D. Arnold. June 9, 1959. 17p. OTS.

The radiation hazards associated with recycled nuclear reactor fuels will greatly complicate the handling and refabrication of these fuels. This problem is most serious with U^{233} and Pu fuels where the presence of U^{232} and the heavier isotopes of Pu contribute energetic alpha, gamma, and neutron radiations at levels many times that from isotopically pure U^{233} and Pu^{239}. Present knowledge of the radiation hazards associated with recycled fuel and the additional data needed to make a thorough evaluation of these hazards are summarized. (auth)

414   HASL-58
Division of Biology and Medicine, AEC and New York
   Operations Office. Health and Safety Lab., AEC.
SYMPOSIUM ON OCCUPATIONAL HEALTH EXPERIENCE AND PRACTICES IN THE URANIUM INDUSTRY, HELD IN NEW YORK CITY, OCTOBER 15-17, 1958. 257p. OTS.

Separate abstracts have been prepared on 38 papers presented at this symposium. A brief summary is included of a panel discussion. (C.H.)

415   HASL-58(p.3-9)
Mallinckrodt Chemical Works, St. Charles, Mo.
A SUMMARY OF FIFTEEN YEARS OF EXPERIENCE WITH DUST PROBLEMS IN THE REFINING AND FABRICATION OF URANIUM. Mont G. Mason. 7p.

The fifteen years of experience with uranium production shows no clinical or medical evidence of damage to workers from chronic exposure, even though some workers had potential high chronic dust exposure in the early years. Dust control continues to be a major health protection problem. The uranium industry as a whole does not have well defined standards for health protection and is faced with continued controversy in the matter of protection versus cost. It is imperative that adequate standards be developed so that the industry can proceed in an orderly manner. Whether the data indicate a need for the program to be conservative or liberal is secondary to the need for uniformity and for a clear definition of minimum performance requirements. (auth)

416   HASL-58(p.10-15)
New York Operations Office. Health and Safety Lab.,
   AEC.

OCCUPATIONAL EXPOSURES TO URANIUM AIR CON-
TAMINATION IN FEED MATERIALS PRODUCTION
FACILITIES, 1948-1956. A. J. Breslin. 6p.

Between 1948 and 1956, there was a radical change in
occupational exposures in the uranium production proc-
esses. In 1948, and probably before that time, 90% of
production workers were exposed to average concen-
trations in excess of the present MAC of 110 d/m/m^3,
and 32% were exposed to average concentrations >1800
d/m/m^3. By 1956, conditions had improved remarkably,
with only 6% of production workers exposed to average
concentrations higher than the MAC. The improvement
was brought about mainly through the construction of
modern processing facilities to replace those that had
been put into operation during the war. (auth)

417   HASL-58(p.16-22)
Los Alamos Scientific Lab., N. Mex.
SURVEY OF AIR-BORNE NORMAL URANIUM FROM
VARIOUS OPERATIONS AT LOS ALAMOS SCIENTIFIC
LABORATORY. Donald A. McKown. 7p.

Since 1953 there has been a general trend downward
in air concentrations in most areas, even in some areas
where no special efforts to reduce concentrations have
been made. (auth)

418   HASL-58(p.23-9)
Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge,
    Tenn.
AIR SAMPLING FOR THE CONTROL OF INTERNAL
EXPOSURE FROM ENRICHED URANIUM AT Y-12.
G. R. Patterson, Jr. 7p.

The program is described for determining the con-
centration of uranium in the air being breathed by per-
sons working in the enriched uranium processing areas
of the Y-12 Plant of Union Carbide Nuclear Company at
Oak Ridge, Tennessee. The aim of the program, ways
to accomplish this aim, and the methods used to process
the data accumulated are mentioned. The Y-12 Plant
limit for permissible concentration of air-borne ura-
nium and its origin or derivation are given. The sam-
pling program and techniques are rather standard, but
mention is made of three unique features: the use of a
cardboard planchet to simplify handling of samples, the
use of automation to expedite sample counting, and the
use of several twin-head sample collectors and statisti-
cal analysis to determine over-all program precision
and optimum sampling frequency. Figures illustrate
air sampling and counting equipment and graphs show
uranium concentrations determined by the program. (auth)

419   HASL-58(p.30-3)
Rochester, N. Y. Univ. Atomic Energy Project.
TOXICOLOGY AND PHARMACOLOGY-ANIMAL DATA.
Elliott A. Maynard and William L. Downs. 4p.

When uranium is absorbed it exhibits marked toxicity.
The characteristic lesion due to the chemical action of
uranium is a renal tubular injury. At the present time,
the data support the present MAC figure insofar as
chemical toxicity is concerned. A two-year exposure
of dogs and monkeys to inhaled UO_2 at ≈ 100 times the
present MAC has not produced kidney injury or shown
any damage that can be attributed to radiation. Urinary
uranium appears to be of questionable value as a meas-
ure of the body burden of uranium, when the exposure
is primarily to insoluble compounds such as uranium
dioxide. (auth)

420   HASL-58(p.34-40)
National Lead Co. of Ohio, Cincinnati.
STUDIES OF HUMAN EXPOSURE TO URANIUM. J. A.
Quigley, R. C. Heatherton, and J. F. Ziegler. 7p.

Data are summarized on the distribution of radio-
activity in tissues obtained at autopsy from subjects
exposed occupationally to external and air-borne ura-
nium. Findings are compared with those on normal
subjects with no exposure to uranium or other radio-
active materials in excess of natural background. Find-
ings substantiate the opinion that the deaths of the em-
ployees were in no way related to their occupations.
(C.H.)

421   HASL-58(p.41-6)
United Kingdom Atomic Energy Authority. Industrial
    Group. Springfields Works, Springfields, Lancs,
    England.
HUMAN DATA ON URANIUM EXPOSURE. A. Butter-
worth. 6p.

Data are summarized which were obtained following
accidents, from normal industrial experience, and from
analysis of tissues obtained post-mortem from em-
ployees of a uranium processing plant. No evidence
was found that any of several thousand employees suf-
fered any injury to the kidneys or other organs as a
result of working with uranium. Data are included on
the relationship between uranium exposure, as air con-
tamination, and resultant effects on the kidneys. It is
concluded that soluble natural uranium should be con-
sidered as a chemotoxic rather than a radiotoxic agent.
Radiotoxicity is probably of importance only when the
specific activity is increased by a factor of 10 or more
above levels encountered in industrial exposure. It is
improbable that either the kidneys or lungs can retain
a maximum permissible amount of soluble natural ura-
nium, since the limiting factor is the renal sensitivity
to the chemotoxic effect. The biological half-time of
UO_2F_2 in the lungs was estimated to be one day. The
biological half-time of soluble uranium in the kidney
was estimated to be considerably less than 30 days, and
probably no more than 15 days. (C.H.)

422   HASL-58(p.53-68)
Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge,
    Tenn.
EVALUATION AND CONTROL OF INTERNAL EXPO-
SURE FROM ENRICHED URANIUM AT Y-12. G. R.
Patterson, Jr. 16p.

This paper presents the details of the program for
evaluating and controlling, within recognized permis-
sible limits, the internal radiation exposures of em-
ployees working in the enriched uranium processing
facilities of the Y-12 Plant of Union Carbide Nuclear
Company at Oak Ridge, Tennessee. Derivation of basic
limits and formulas for estimating internal dose from
the results of urinalysis; the use of machine tabulators;
and the applications of statistical analysis for the con-
trol of analytical precision and evaluation of the re-
liability of dose estimates are all discussed. Steps in
the procedure for a simplified method of electrodeposi-
tion of uranium from urine are included. At the Y-12
Plant a fluorometric method is used for the quantitative
detection of uranium in the urine of employees process-
ing only normal or depleted uranium; however, this
paper deals only with the program for evaluating expo-
sures to enriched uranium. (auth)

423   HASL-58(p.69-76)
National Lead Co. of Ohio, Cincinnati.
A URANIUM REFINERY AND METAL PLANT URINE
PROGRAM AND DATA. R. C. Heatherton and J. A.
Huesing. 8p.

This paper describes the urinary uranium program
at the Fernald, Ohio, Feed Materials Production Center

and its development over a six-year period from August 1952 to the present. An IBM program on trial since January 1958 has provided information used in the interpretation of urinalysis results. Results, correlated data, and interpretations are given. It is concluded that a good urinanalysis program with careful documentation of the data is essential to the evaluation of occupational uranium exposure and its effects. (auth)

424   HASL-58(p.77-84)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
THE HANFORD URANIUM BIO-ASSAY PROGRAM. R. H. Wilson. 8p.

Hanford uranium bio-assay sampling methods and evaluation of body burdens are based primarily on studies made at the University of Rochester. Before and after exposure samples are collected on a weekly or monthly basis according to the potential for exposure. In addition, supplemental before and after samples are collected whenever the potential for exposure appears significant, in order to assist in establishing the possible time of intake. Analysis for uranium in urine samples is done by the fluorometric method with a detection limit established at 3.8 $\mu g/l$. Results of the Hanford bio-assay program during the past several years indicate that no significant chronic internal deposition problem exists in the uranium processing facilities. (auth)

425   HASL-58(p.85-8)

Los Alamos Scientific Lab., N. Mex.
URANIUM URINALYSIS DATA AT LOS ALAMOS SCIENTIFIC LABORATORY. E. E. Campbell, Jean McClelland, D. D. Meyer, and E. C. Hyatt. 4p.

The urine sampling program for normal uranium workers is reviewed. Improved analytical methods are discussed which employ a dibutyl phosphate procedure on 100-ml aliquot samples. Samples collected morning and evening for two days gave more consistent results than were obtained from spot samples. (C.H.)

426   HASL-58(p.89-94)

Knolls Atomic Power Lab., Schenectady, N. Y.
KAPL EXPERIENCES IN URANIUM HEALTH PROGRAMS. M. R. Kennedy. 6p.

The facilities for machining uranium at the Knolls Atomic Power Laboratory are discussed. The health physics aspects of the uranium health program are summarized, including air cleaning systems, calculations of maximum permissible urinary excretion levels, bio-assay analyses, and typical bio-assay results. (auth)

427   HASL-58(p.95-7)

Oak Ridge National Lab., Tenn.
INTERSPECIES CORRELATIONS. W. S. Snyder. 3p.

Procedures for calculating the maximum permissible concentration of uranium for man are discussed. A method based on kidney toxicity is described in detail. A formula is presented for use in calculations. Data are discussed on the relationship of uranium level in the kidney to toxicity. Estimates of the half-time of uranium in the kidney are included for mice, rats, and man. Problems involved in extrapolation from animal data to man are discussed. (auth)

428   HASL-58(p.103-14)

New York Operations Office. Health and Safety Lab., AEC.
CORRELATION OF URINE DATA AND MEDICAL FINDINGS WITH ENVIRONMENTAL EXPOSURE TO

URANIUM COMPOUNDS. Morton Lippmann. 12p.

Air and urine data and medical findings covering a 2-year period have been presented for employees of two plants of a uranium refinery. The Plant 1 personnel were exposed to insoluble uranium compounds, the Plant 2 personnel to soluble uranium. Monthly average air dust exposures to soluble uranium compounds were as high as 3500 $\mu g/m^3$. For 29 men exposed at this level, the median before-weekend urine concentration was 900 $\mu g/l$; 25% were >2000 and the highest was 13,200 $\mu g/l$. None of these men showed any diminution of renal function, but 3 of the 29 had abnormal urine findings. For men exposed to lower air concentrations, no clinical symptoms and only occasional urine abnormalities were found. Monthly average air dust concentrations of insoluble uranium compounds were as high as 9700 $\mu g/m^3$. Although respirators were worn at some operations, they could not have reduced average exposures by more than 75%, so that some exposures were in the milligram per cubic meter range. For 8 men so exposed, 8 of 33 after-weekend urines contained >67 $\mu g/l$, the highest showing 108 $\mu g/l$. For men who worked in average air concentrations up to 4400 $\mu g/m^3$, only 1 urine sample in 118 was >67 $\mu g/l$. The urinary excretion rate following heavy exposures was found to drop steadily for several weeks, and the rate of excretion at any subsequent time was found to be a function of time and of the excretion rate during the first day following exposure. No useful correlation could be found between air concentration of soluble uranium compounds and before-weekend urine concentration, or between air concentration of insoluble uranium compounds and after-weekend urine concentration. In addition, it was shown that an after-weekend urine sample does not provide an accurate indication of uranium body burden. (auth)

429   HASL-58(p.115-25)

Westinghouse Electric Corp., Pittsburgh.
CORRELATION OF URINE DATA WITH ENVIRONMENTAL EXPOSURE TO URANIUM. J. E. Ross. 11p.

An investigation was made of uranium intake versus urinary excretion in a group of 15 men exposed primarily to enriched uranium during 16 to 102 months of employment in a uranium-235 fuel alloy shop. Data are presented graphically and results are discussed. (C.H.)

430   HASL-58(p.126-35)

Oak Ridge National Lab., Tenn.
ESTIMATION OF BODY BURDEN AND INTERNAL DOSE BASED UPON URINARY URANIUM. Birney R. Fish. 10p.

Urinary uranium excretion data from 12 humans receiving intravenous injections of hexavalent uranium have provided a pattern relating body burden to excretion rate. This relationship should be useful in inhalation exposures involving soluble compounds in addition to cases of wound contamination. A U_3O_8 inhalation case has been studied by several methods: air sampling, blood sampling, in vivo gamma counting, and urine analysis. All these procedures yield tenable estimates of the exposure dose, but urinalysis and in vivo counting provide what are believed to be the best estimates. A suggested framework for rapidly estimating acute inhalation exposure has been based upon two cases of accidental inhalation of uranyl nitrate and one U_3O_8 inhalation. It is evident that a great many more data are needed before such an approach as this can be made useful. (auth)

431   HASL-58(p.136-8)
Rochester, N. Y. Univ. Atomic Energy Project.
URINARY URANIUM AS AN INDICATOR OF DOSE TO
EXPOSED PERSONNEL. John B. Hursh. 3p.

The importance is emphasized of the human data
which has been and is being collected in the field. It is
apparent that there is a great need for more such data:
for detailed measurements on accident cases; for job-
rating exposure values arrived at by air sampling and
by urinary and fecal measurements; for more autopsy
data on workers whose exposure can be estimated with
reasonable accuracy; and for medical vigilance in pick-
ing up late effects if they appear. In view of the circum-
stance that the exposure of workers to uranium in the
early years was much greater than it is likely to be in
the future, it is very important that these people be kept
track of in a central file, that they receive regular
medical examinations, and that every effort be made to
obtain autopsy samples at their death. For the general
elucidation of our remaining problems with uranium
this human material is priceless and cannot be sub-
stituted for by experiments in the laboratory. (auth)

432   HASL-58(p.139-40)
Rochester, N. Y. Univ. Atomic Energy Project.
GENERAL COMMENTS ON URINARY URANIUM ANAL-
YSIS. W. F. Neuman. 2p.

The author points out that analysis of urine for ura-
nium is a poor measure of exposure. However, it is the
most convenient and one of the best methods available.
The metabolism of uranium is discussed briefly. It is
concluded that there is no single half-time for the depo-
sition of uranium in bone, but the half-time is a direct
function of length of time of observation. (C.H.)

433   HASL-58(p.147-50)
Mallinckrodt Chemical Works, St. Charles, Mo.
IS THERE SIGNIFICANT CORRELATION BETWEEN
ALPHA SURFACE CONTAMINATION AND AIR CON-
CENTRATION OF RADIOACTIVE PARTICLES IN A
URANIUM FEED MATERIALS PLANT? W. L. Utnage.
4p.

A study of alpha surface contamination and alpha air
concentration was made to determine whether or not
there is significant correlation between surface con-
tamination and air concentration in a plant where normal
operations contribute sufficient alpha dust particles to
the environmental air to produce average air concen-
trations greater than zero but less than the MAC estab-
lished by NBS handbooks. It is concluded from the re-
sults of this survey that there is no correlation between
alpha surface contamination and air concentrations in
uranium feed materials plants designed and operated as
currently approved. At present we do not have, and do
not know how to design, a process for refining thousands
of tons of uranium concentrate per year that would en-
able the absolute confinement of uranium. So long as we
operate under the philosophy that some uranium in air,
creating air concentrations less than one MAC, is ac-
ceptable, very little emphasis should be placed on sur-
face contamination. If the uranium refining operations
were to be done on the basis that there should be no
escape of normal uranium, then obviously greater em-
phasis would have to be placed on surface contamina-
tion, and the contamination would have to be reduced to
a very low level. (auth)

434   HASL-58(p.151-6)
Union Carbide Nuclear Co. K-25 Plant, Oak Ridge,
Tenn.

THE DEVELOPMENT OF SURFACE ALPHA CON-
TAMINATION LIMITS. A. F Becher. 6p.

Inhalation of the various uranium compounds proc-
essed or handled in large-scale production facilities is
the primary health hazard associated with uranium,
and, since the action of inhalation is an involuntary one,
some type of external detection and control is required.
Sampling of the environmental air is usually considered
to be the most direct and efficient means of evaluating
the personnel exposure potential. The local program in-
includes the use of commercially available high volume
air samplers, low flow rate samplers (approximating
the breathing rate of man) used for obtaining breathing
zone samples for specific operations or service activi-
ties, and locally developed continuously recording air
samplers. These last record both 0.5-hr peak values
and 8-hr average values on a tape, which is also identi-
fied as to time, date, and year for the recorded sample.
An alarm device is under local development for use in
conjunction with or independent of the above recording
unit. The performance of monitoring equipment is de-
scribed. From the work reported it is concluded that
surface contamination levels, as expressed by the con-
tamination indices, will reflect operational changes or
inadequacies in the control methods. High surface con-
tamination levels are almost invariably identified with
correspondingly high air activity measurements.
Standardization of survey techniques and areas permits
a rapid, simple determination of the surface contamina-
tion levels to be made by relatively inexperienced per-
sonnel, which, when expressed in terms of the con-
tamination index, provides management with an effective
yardstick to measure performance and evaluate the ef-
fectiveness of the control measures employed. (auth)

435   HASL-58(p.157-61)
Union Carbide Nuclear Co. K-25 Plant, Oak Ridge,
Tenn.
PERSONNEL CONTAMINATION AS A URANIUM HAZ-
ARD. J. C. Bailey. 5p.

Measurements of surface contamination provide a
very useful indicator of general contamination condi-
tions. On the basis of such measurements reasonable
control requirements for general operations can be
established in locations varying widely with regard to
the degree of uranium intake that may be experienced
therein. Where personnel contamination by uranium
represents a source of any significant exposure, the
control of direct air-borne contamination is a much
more important consideration. The delineation of areas
where clothing contamination might represent a signifi-
cant source of uranium intake has permitted technically
sound administrative decisions concerning the condi-
tions under which company-issued clothing should be
regarded as protective clothing and where it should be
regarded simply as work clothing. (auth)

436   HASL-58(p.162-7)
General Electric Co. Hanford Atomic Products Opera-
tion, Richland, Wash.
EXPERIENCE OF A PLANT OPERATED LAUNDRY.
K. R Heid and E. C Watson. 6p.

Decontamination laundry facilities are described for
processing clothing potentially contaminated with pluto-
nium, uranium, fission products, or combinations of
these. Recognized commercial laundering agents were
found to have little value in removing normal radio-
active contaminants. Compounded agents containing
glassy phosphate salts and carbonate and ammonium

ions proved to be more effective. These agents are tabulated, and results of tests are included. (C.H.)

437   HASL-58(p.168-71)
Mallinckrodt Chemical Works, St. Charles, Mo.
LAUNDRY OPERATIONS IN A URANIUM FEED MATE-
RIALS PLANT. W. L. Utnage. 4p.

Clothing contaminated with significant amounts of
uranium may not be released to public laundries ac-
cording to the recommendations of the NCRP. Release
of clothing to commercial laundries would require some
prewashing in most cases and extensive monitoring and
separation facilities. Contamination levels would have
to be below maximum levels established by the NCRP.
When contamination levels are the controlling factor,
cost advantage is irrelevant, whether favoring in-plant
or outside laundry service. NBS handbook recom-
mendations should be followed. For long-term con-
sideration there is no cost advantage in using outside
laundry service. In fact, in Mallinckrodt's operation,
there is a definite cost advantage in using an in-plant
laundry. Better control of contamination is achieved
with an in-plant laundry. No commercial laundries
were found that were licensed by the AEC to handle
uranium and had the necessary ventilation equipment
installed to achieve good health conditions. (auth)

438   HASL-58(p.172-4)
M & C Nuclear, Inc., Attleboro, Mass.
EXPERIENCE WITH COMMERCIAL LAUNDRY OPER-
ATIONS. Peter Loysen. 3p.

Experiences are reported in the use of an AEC-
licensed commercial laundry for the care of protective
clothing worn by employees of a nuclear fuel fabrica-
tion plant working with uranium and thorium and their
oxides. Cost factors and health protection are dis-
cussed. (C.H.)

439   HASL-58(p.175-9)
National Lead Co. of Ohio, Cincinnati.
EVALUATION OF ENVIRONMENTAL URANIUM CON-
TAMINATION AT THE FEED MATERIALS PRODUC-
TION CENTER. Aubrey O. Dodd and Keith N. Ross.
5p.

The processing of normal uranium with its extremely
low specific activity does not suggest a significant
health problem when compared with that of radium or
some of the longer-lived fission products. The possi-
bility of renal damage due to its chemical toxicity, how-
ever, justifies considerable effort to control uranium
and its associated decay products. At the AEC Feed
Materials Production Center operated by National Lead
Company of Ohio at Fernald, Ohio, the emphasis has
been upon engineering into process operations a high
degree of control of radioactive materials in order to
keep to a practical minimum the release of such mate-
rials to the total environment. These control measures
and monitoring procedures are described. (C.H.)

440   HASL-58(p.180-4)
New York Operations Office. Health and Safety Lab.,
AEC.
ENVIRONMENTAL CONTAMINATION. Martin S. Wein-
stein. 5p.

Results of environmental pollution studies conducted
by HASL at natural uranium processing facilities indi-
cate little, if any, contamination of soil, water, or air.
Estimates indicate a loss of about $2,000,000 worth of
uranium in stack effluents at three major facilities over
a 14-year period. Examination of some of the economic
aspects of environmental pollution control indicates the

practicality of the installation of air cleaning equipment.
(C.H.)

441   HASL-58(p.189-94)
Union Carbide Nuclear Co. Paducah Plant, Ky.
BETA EXPOSURE DURING URANIUM PROCESSING.
R. C. Baker. 6p.

The beta-emitting materials associated with uranium
processes are concentrated by fluorination of UF_4 to
UF_6, vaporization of UF_6, and impaction on process
components, and during metal casting. This concentra-
tion does not prohibit contact maintenance and opera-
tion, but increases the problems. The resulting expo-
sures respond to the applied control measures and are
within acceptable limits. Clothing contaminated with
concentrated beta emitters presents a difficult moni-
toring problem, in which the accumulated dose is ap-
proximated by applying statistics from spot checks.
(auth)

442   HASL-58(p.195)
Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge,
Tenn.
IN VIVO COUNTING AS A DEVICE FOR EVALUATING
URANIUM EXPOSURE. L. E. Burkhart. 1p.

Whole-body counting of individuals following enriched
uranium inhalation is described. The general configura-
tion is described of a $7 \times 7 \times 7$-ft shield with 8-in. steel
walls. The data, derived primarily from measurements
in this shield, are coded on a 250-channel spectrum
analyzer. Background measurements, phantom meas-
urements, and measurements of certain individuals are
discussed. Some comparisons are made of whole-body
measurements and urine data following inhalation.
Whole-body counts are presented for 15 to 20 patients,
but it is emphasized that the data are preliminary and
unevaluated. (auth)

443   HASL-58(p.196-9)
United Kingdom Atomic Energy Authority. Research
Group. Atomic Energy Research Establishment,
Harwell, Berks, England.
POSSIBILITIES AND LIMITATIONS OF WHOLE-BODY
COUNTING IN ASSESSING BURDENS OF NATURAL
URANIUM. J. Rundo. 4p.

The detection of uranium in the human body by in vivo
counting is possible by using sodium iodide crystals and
gamma-ray spectrometry, but the sensitivity is not very
great and calibration presents a formidable problem.
However it should be possible to measure down to about
one third of the maximum permissible level for skeletal
deposition, with an error of perhaps 25 or 30%. This
would be satisfactory for checking occasional cases
where contamination has been demonstrated by the find-
ing of uranium in urine or feces. By following reduction
in the body activity and determining the amount of ura-
nium excreted, a check on the calibration would be ob-
tained, which would lend confidence to future measure-
ments. However, the time required to interpret the
gamma-ray spectrum would probably preclude the use
of the technique as a routine tool, and it is unlikely ever
to supplant urinalysis. (auth)

444   HASL-58(p.200-7)
Los Alamos Scientific Lab., N. Mex.
AIR SAMPLING PROCEDURES IN EVALUATING EX-
POSURES TO URANIUM. E. C. Hyatt and H. F. Schulte.
8p.

Air sampling procedures used to evaluate the degree
of air contamination in uranium workshops are dis-
cussed. Design features and performance of air sam-
pling equipment are described. (C.H.)

445   HASL-58(p.208-11)
New York Operations Office.   Health and Safety Lab.,
   AEC.
AIR SAMPLING PROCEDURES IN EVALUATING EX-
POSURES. H. Glauberman and W. B. Harris. 4p.

Statistical treatment of available data shows that in
most cases no one type of sample will suffice to evalu-
ate a variable occupational exposure properly. Multiple
general air (GA) samples obtained at carefully selected
locations by an experienced sampler in a continuous
process area may be employed to evaluate occupational
exposure with reasonable confidence. This is possible
in a continuous operation, with little change in air tur-
bulence, where the change in concentration within a lo-
cation is small compared to the difference in concen-
trations between locations over long periods of time. In
a plant where various operations are performed, some
intermittently, repetitive GA samples alone will not
represent true exposure and can vary from it by many
orders of magnitude. The use of breathing zone (BZ)
samples alone, taken at different time intervals, will
also lead to an erroneous occupational exposure, much
greater than the true one. A close appraisal of true ex-
posure may be achieved by obtaining multiple GA sam-
ples in all areas normally occupied by plant personnel
as well as repetitive BZ samples at all operations con-
ducive to high concentrations. The GA sample normally
will tend to underestimate an operator's exposure and
the BZ sample to overestimate it, but by time weighting
the average concentrations for both types of samples an
operator's exposure may be closely evaluated. The data
indicate that this type of treatment yields reasonably
reproducible results. (auth)

446   HASL-58(p.212-13)
New York Operations Office, AEC.
DISCUSSION OF APPARENT ANOMALIES IN LUNG
RETENTION OF URANIUM. Merril Eisenbud. 2p.

The influence of dust density on lung deposition of
uranium dust is discussed. Data are reviewed on lung
concentration of uranium in two workers who died of
natural causes. Apparent anomalies in uranium lung
retention data are discussed. (C.H.)

447   HASL-58(p.214)
[Robert A. Taft Sanitary Engineering Center],
   Cincinnati.
A TEST OF RESPONSE TO EXPOSURE. H. E.
Stokinger. 1p.

A direct correlation is reported in exposure to vana-
dium, urinary excretion of vanadium, and quantitative
measurements of the amount of cystine in the finger-
nails. The test has also been tried for a number of
chronic diseases such as diabetes and heart disease.
The test has never been applied in cases of radiation
exposure, but it is suggested that it may have possibili-
ties. (C.H.)

448   HASL-58(p.215)
[Occupational Health Field Station], Salt Lake City.
URANIUM IN TISSUES, A CASE HISTORY. Duncan A.
Holaday. 1p.

Data are presented on the distribution of uranium in
lung tissues obtained at autopsy from a miner who
worked in a uranium mine for about five years. It is
suggested that possibly physical condition has a marked
effect on the distribution and metabolism of uranium in
the body. (C.H.)

449   HASL-58(p.216-18)
Oak Ridge National Lab., Tenn.
URINALYSIS SUMMARY. Birney R. Fish. 3p.

The validity of urinalysis as a means of estimating
the body burden or exposure to uranium is discussed.
The need for uniformity of methods is stressed. (C.H.)

450   HASL-58(p.219-21)
New York Operations Office.   Health and Safety Lab.,
   AEC.
AIR SAMPLING SUMMARY. W. B. Harris. 3p.

The effectiveness of air sampling to evaluate the haz-
ards during uranium processing is discussed. It is
pointed out that the type of operation will strongly in-
fluence the type of air sampling program. It is con-
cluded that air sampling gives a good estimate of expo-
sure. (C.H.)

451   HASL-58(p.222-5)
Division of Biology and Medicine, AEC.
MEDICAL FINDINGS SUMMARY. T. S. Ely. 4p.

Data on the pathological effects of uranium in man
and laboratory animals are summarized. The validity
of the figures for maximum permissible levels for ura-
nium set by the International Committee on Radiation
Protection is discussed. (C.H.)

452   HASL-58(p.229-40)
New York Operations Office.   Health and Safety Lab.,
   AEC.
PANEL DISCUSSION. M. Eisenbud, E. C. Barnes, T. S.
Ely, H. F. Henry, E. C. Hyatt, W. F. Neuman, J. A.
Quigley, and E. C. Watson. 12p.

Varied views are presented on the hazards of the ura-
nium industry. It was suggested that a committee be
appointed by the AEC Division of Biology and Medicine
to attempt to standardize certain procedures such as
air sampling, urinalysis methods and frequency, and
target levels for the guidance of those responsible for
the health and safety of workers in uranium processing
plants. (C.H.)

453   HW-36074(Del.)
General Electric Co. Hanford Atomic Products Opera-
   tion, Richland, Wash.
RADIOBIOLOGICAL STUDIES OF THE COLUMBIA
RIVER THROUGH DECEMBER 1955. J. J. Davis, D. G.
Watson, and C. C. Palmiter. Nov. 7, 1956. Decl. with
deletions July 31, 1959. 177p. Contract W-31-109-
Eng-52. OTS.

Radiobiological studies were made to determine ef-
fects of radioactive effluents from the Hanford reactors
on the aquatic biota of the Columbia River and to evalu-
ate related hazards. Data from studies completed be-
tween September 1948 and December 1955 are presented
and interpreted All forms of life were many times
more radioactive than the water they inhabited. Some
radioisotopes were much more readily accumulated
than others in living organisms. Differences in the con-
centration of certain radioisotopes by various species
of organisms and kinds of body tissue are described;
and geographical, seasonal and annual fluctuations in
the concentration of radioisotopes in organisms are
discussed. (auth)

454   HW-40809
General Electric Co. Hanford Atomic Products Opera-
   tion, Richland, Wash.
BETA FIELD DOSE RATE DETERMINATION WITH
THE C.P. DOSE RATE METER. Iral C. Nelson.
Jan 6, 1956. 14p. Contract W-31-109-Eng-52. OTS.

An experimental method of field dose rate deter-
mination using dose rate meters was developed. The
method utilizes the factor obtained by forming the ratio
of the total integrated dose rate obtained with the for-

ward axis of the chamber intersecting the center of the incremental source to the total integrated dose obtained with the forward axis of the chamber intersecting the center of the integrated source. Data were taken and analyzed in accordance with this method for the C.P. dose rate meter. Correction factors were determined for beta field determination with the C.P. dose rate meter. (C.H.)

455   HW-59500

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

HANFORD BIOLOGY RESEARCH ANNUAL REPORT FOR 1958. J. J. Davis, ed. Jan. 5, 1959. 156p. Contract W-31-109-Eng-52. OTS.

Separate abstracts are presented on the papers presented in this report. A list is included of papers presented at formal meetings and publications during the period. (For preceding period see HW-53500.) (C.H.)

456   HW-59500(p.11-15)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

METABOLISM OF Sr^{90} IN SWINE. J. R. McKenney, W. J. Clarke, V. G. Horstman, L. A. George, and D. L. Anderson. 5p.

Skeletal burdens of mature swine 15 days after oral administration of 100 μc of Sr^{90} were 2 to 6% of the administered dose, compared to 20 to 30% for 115-day-old swine and 8 to 13% for 72-day-old swine. The level of Sr^{90} in the blood of the mature swine peaked within 4 to 8 hours after isotope feeding. (auth)

457   HW-59500(p.16-19)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

THE UPTAKE OF STRONTIUM FROM DIET AND WATER BY RAINBOW TROUT. R. H. Shiffman. 4p.

The concentration ($\mu c/g$) of $Sr^{90}-Y^{90}$ in trout approached about 1.5 times the concentration ($\mu c/ml$) in the surrounding water in three weeks. Approximately 21% of the isotope administered in gelatin capsules was retained after one day but when incorporated into natural food, the retention was only about 7%. Fish which ingested 0.24 μc $Sr^{90}-Y^{90}$ each day evidenced damage to the gut. (auth)

458   HW-59500(p.20-8)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

STRONTIUM—CALCIUM INTERRELATIONSHIPS IN THE MATURE AND GROWING RAT. R. F. Palmer, R. C. Thompson, and H. A. Kornberg. 9p.

Chronic feeding and single dose retention studies in rats indicate that the ratio of Sr^{90}/Ca deposited in bone, as compared to the ratio Sr^{90}/Ca in the diet, is not a constant, but changes with the level of calcium in the diet and with the age of the animal. The retention of Sr^{90} in bone was shown to be independent of dietary calcium level, in contrast to the retention of Ca^{45}, which increased as the calcium level of the diet was lowered. (auth)

459   HW-59500(p.29-32)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

EFFECTS OF DIETARY CALCIUM ON THE METABOLISM OF Sr^{90} AND Ca^{45} IN EWES AND SUCKLING LAMBS. W. J. Clarke, J. R. McKenney, V. G. Horstman, and G. D. Smith. 4p.

Bone concentrations in ewes (expressed as percentage of daily dose per gram of skeleton) after ten days of

daily feeding of 200 μc each of Ca^{45} and $Sr^{90}-Y^{90}$ (equilibrium mixture) were 0.03 to 0.006% for Ca^{45} and 0.01 to 0.02% for Sr^{90} at levels of 0.8 to 1.2% dietary calcium. Compared to ewes, suckling lambs showed a greater discrimination against Sr^{90} in bone. Ca^{45} and Sr^{90} concentrations approached constant values in blood and milk within five to six days after initiation of feeding. The average ratio of Sr^{90} in milk to blood was significantly lower than that for Ca^{45}. (auth)

460   HW-59500(p.33-40)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

INFLUENCE OF CALCIUM ON Sr^{90} UPTAKE. R. L. Uhler. 8p.

Available calcium was the most significant factor studied which reduced uptake by plants of radiostrontium from soil. Time to equilibrate insoluble and soluble forms of strontium in soil was found to be long. Slight differences in relative concentrations of Sr^{85} and Ca^{45} were noted in different plant parts. (auth)

461   HW-59500(p.41)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

FORMATION CONSTANTS OF CALCIUM, STRONTIUM, AND YTTRIUM FOR ANIONS OF BIOLOGICAL SIGNIFICANCE. J. Olivard. 1p.

Formation constants for a number of biochemically important anions which form complexes with calcium, strontium, and yttrium were evaluated by ion-exchange methods. The formation constants with pyrophosphate are reported for calcium, strontium, and yttrium. (auth)

462   HW-59500(p.42-6)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

EFFECTS OF SOME ENVIRONMENTAL FACTORS ON BIOACCUMULATION OF CESIUM-137 IN AN AQUATIC COMMUNITY. R. C. Pendleton. 5p.

Algae, submerged seed plants, grass, fish, and amphibians changed Cs^{137} contamination levels in response to temperature variations. Shading reduced uptake by submerged plants, and emergent plants rooted in gravel accumulated more Cs^{137} than those rooted in mud. Contamination levels in all organisms decreased because of loss to bottom mud and dilution by increased biomass. Highest contamination generally occurred in the highest trophic levels. (auth)

463   HW-59500(p.47-53)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

BIOLOGICAL EFFECTS OF I^{131} IN SHEEP AND SWINE. V. G. Horstman, D. L. Anderson, L. A. George, S. Marks, and W. J. Clarke. 7p.

Thyroid adenomas were observed in two additional sheep, making a total of eight of nine animals exposed to 5 $\mu c/day$ of I^{131} for their lifetime that have shown tumor involvement. A slight reduction in thyroid avidity for radioiodine was noted in eight-month-old swine fed 5 $\mu c/day$ since being weaned from dams on the same regimen. More I^{131} was deposited in the thyroid glands of full-fed swine than of those on limited nutritional intake. (auth)

464   HW-59500(p.54-60)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PLUTONIUM METABOLISM IN MINIATURE SWINE. W. J. Clarke, J. R. McKenney, V. G. Horstman, L. J. Seigneur, J. L. Terry, and L. K. Bustad. 7p.

The percentage of administered dose of Pu^{239} retained by adult miniature swine at 600 days was about 20,000 times greater after intravenous than after intragastric administration. The plutonium showed a higher concentration in liver than in bone, regardless of path of entry. The elimination rate of the isotope was dependent on route of administration, being slowest after intravenous dosing. (auth)

465   HW-59500(p.61-2)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
SYNERGISTIC EFFECTS OF INTERNALLY DEPOSITED PLUTONIUM AND EXTERNAL X-IRRADIATION. J. E. Ballou. 2p.

Survival time of rats injected with an $LD_{50/72}$ dose of Pu^{239} was markedly reduced by an x ray dose of as little as 200 r. (auth)

466   HW-59500(p.73-7)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
EFFECTS OF CHRONIC FEEDING OF PHOSPHORUS-32 ON RAINBOW TROUT. D. G. Watson, L. A. George, and Patricia L. Hackett. 5p.

Phosphorus-32 fed daily for six months at the rate of 0.006 μc per gram body weight produced no abnormalities in trout. At the 0.06 μc feeding level, rate of growth was reduced in 17 weeks and about 62% of the administered P^{32} was retained. Effective half-life ranged from 8.4 days in liver to 14 days in bone. The 0.6 μc level was lethal, with reduction in rate of growth at 11 weeks and damage to the GI tract, anterior kidney, and reduction of leukocytes at three weeks. (auth)

467   HW-59500(p.78-80)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
SIGNIFICANCE OF GONAD IRRADIATION IN EXPOSURE TO INTERNALLY DEPOSITED PHOSPHORUS-32. B. Kawin. 3p.

Data are presented for the retention of P^{32} in ovary and bone over a period of 56 days following single intraperitoneal administration. Concentrations of P^{32} in ovary decreased as a power function of time, while concentrations in bone remained constant throughout the period of observation. The results suggest that considerations of genetic damage may prove to be the limiting factor in determining maximum permissible limits for P^{32}. (auth)

468   HW-59500(p.81-6)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
METABOLISM OF ZINC-65. J. E. Ballou. 6p.

Approximately 50% of ingested Zn^{65} is absorbed from the gastrointestinal tract of mature rats as judged from ratios of urinary to fecal excretion of the radioisotope during and following a period of chronic feeding. Tissues attaining the highest concentrations of Zn^{65}, during 200 days of chronic administration, were bone and dorsolateral prostate. The MPC calculated for bone as critical organ was 1.4×10^{-2} $\mu c/ml$. Based on prostate as critical organ, the calculated MPC is 3×10^{-3} $\mu c/ml$. The 24-hour retention of Zn^{65} absorbed from the gastrointestinal tract of very young rats was as much as 5.5 times the adult level. (auth)

469   HW-59500(p.87-9)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

EFFECT OF SOIL TYPE AND SOIL PLACEMENT OF Zn^{65} ON UPTAKE BY PLANTS. J. F. Cline. 3p.

Movement of Zn^{65} in calcareous soil was slight under all conditions tested. Zn^{65} stratified in this soil was nearly equally available to the plant at all positions tested. In acid soil movement of Zn^{65} was increased by presence of exchangeable ions in the eluting solution and stratification affected the amount of Zn^{65} taken up by plants. (auth)

470   HW-59500(p.90-3)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
METABOLISM OF TUNGSTEN-185. J. E. Ballou. 4p.

Investigation of the metabolism of W^{185} in rats suggests that the critical organ and the values for certain metabolic parameters may be different from those presently listed by the International Commission on Radiological Protection. The effect of these changes on the calculated maximum permissible concentration in water is relatively minor. (auth)

471   HW-59500(p.94-6)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
POLONIUM DISTRIBUTION IN YEAST. R. T. O'Brien. 3p.

Using autoradiographic methods it was shown that Po^{210} is mainly adsorbed to the surface of yeast cells. (auth)

472   HW-59500(p.97-100)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
AEROSOL EXPOSURE THROUGH A SURGICALLY PREPARED TRACHEAL FISTULA. G. D. Smith and W. J. Bair. 4p.

About half of the $Sr-Y^{90}$ inhaled as $Sr^{90}SO_4$ particles through a surgically prepared tracheal fistula in a dog was rapidly translocated from lung to bone, and about half was excreted. (auth)

473   HW-59500(p.101-5)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
BEHAVIOR OF INHALED RADIOACTIVE PARTICLES IN MICE: ($Pu^{239}O_2$, $Ru^{106}O_2$, $Sr^{90}SO_4$, I^{131}, and AgI^{131}). W. J. Bair, D. H. Willard, L. A. Temple, and G. D. Smith. 5p.

After inhalation of $Pu^{239}O_2$ or $Ru^{106}O_2$ only small quantities were observed to be translocated from lung to other tissues. About three per cent of that deposited in lung was retained with a half life of 460 days for Pu^{239} and 230 days for Ru^{106}. Inhaled $Sr^{90}SO_4$, AgI^{131}, and I^{131} were rapidly translocated to bone and thyroid. (auth)

474   HW-59500(p.106-8)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
TUMORIGENICITY OF INTRATRACHEALLY ADMINISTERED PARTICLES. L. A. Temple, S. Marks, and W. J. Bair. 3p.

Several malignant pulmonary tumors were seen following intratracheal injection of $Pu^{239}O_2$ or $Ru^{106}O_2$. Total doses to lung tissue, assuming a 30-day biological half life and uniform distribution of particles, were estimated. (auth)

475   HW-59500(p.109-10)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

THERAPY FOR LUNG DEPOSITED RADIOACTIVE
PARTICLES. D. H. Willard. 2p.

Frequent inhalation of aerosols of either NaCl, ANTU
(alpha-naphthylthiourea), $AgNO_3$, H_2O_2, or H_2S gas more
than doubled the rate of clearance of pulmonary de-
posited $Ru^{106}O_2$. (auth)

476   HW-59500 (p. 111-16)
General Electric Co. Hanford Atomic Products Opera-
tion, Richland, Wash.
EFFECT OF GASTROINTESTINAL TRACT IRRADIA-
TION ON NUCLEIC ACID METABOLISM. M. F.
Sullivan. 6p.

DNA synthesis in the intestine is depressed within
one hour following whole-body exposure to 1500 r. In
animals exposed to irradiation of the exteriorized in-
testine, DNA synthesis does not return to normal for at
least a week following exposure. Shielding a portion of
the intestine does not diminish the initial effect, but
does enhance the recovery process, in adjacent irradi-
ated segments. (auth)

477   HW-59500 (p. 117-19)
General Electric Co. Hanford Atomic Products Opera-
tion, Richland, Wash.
CHRONIC IRRADIATION OF THE GASTROINTESTINAL
TRACT BY INGESTED RADIOISOTOPES. M. F. Sulli-
van. 3p.

The maximum tolerated chronic dose of ingested Y^{90}
for the rat lies between 0.4 and 0.6 mc/day. Hemato-
logic damage from such exposure is limited to lympho-
penia. Histologic damage is confined to the intestine
and is similar to that caused by acute Y^{90} ingestion.
The amount of Y^{90} absorbed does not exceed 0.01% of
the ingested dose and should not appreciably alter the
toxicity. (auth)

478   HW-59500 (p. 120-2)
General Electric Co. Hanford Atomic Products Opera-
tion, Richland, Wash.
RADIATION SENSITIVITY OF CYTOCHROME DEFI-
CIENT YEAST. R. T. O'Brien. 3p.

Increased sensitivity of cytochrome deficient yeast
strains to x rays is related to decreased catalase and/
or cytochrome content in cells of these strains. (auth)

479   HW-59500 (p. 123-5)
General Electric Co. Hanford Atomic Products Opera-
tion, Richland, Wash.
LOSS OF CELLULAR CONSTITUENTS FROM X-
IRRADIATED YEAST. R. T. O'Brien. 3p.

Irradiated yeasts showed more leakage of phosphorus
and potassium than control cells. Dose response data
suggested that different systems are involved in reten-
tion of potassium and phosphorus by the cell. (auth)

480   HW-59500 (p. 126)
General Electric Co. Hanford Atomic Products
Operation, Richland, Wash.
ERIOGLAUCINE AS AN X-RAY PROTECTIVE AGENT.
V. H. Smith and D. R. Kalkwarf. 1p.

Erioglaucine, a blue dye, shown to protect against
ionizing radiation effects in vitro, was investigated as a
protective agent in vivo. Seven out of ten mice receiving
800 r x radiation (250 KVP) survived for 30 days when
given erioglaucine, intraperitoneally, at a dose level of
1 g/kg, ten minutes prior to irradiation. Only one of
ten similarly irradiated, but unprotected, animals sur-
vived. Further experiments are planned to correlate
in vitro and in vivo results, and to provide information

on structure-effect correlation and the theory of pro-
tective action. (auth)

481   HW-59500 (p. 127-31)
General Electric Co. Hanford Atomic Products Opera-
tion, Richland, Wash.
BONE-MARROW TRANSPLANTATION IN LETHALLY
X-IRRADIATED SWINE. W. J. Clarke. 5p.

The efficacy of isologous bone-marrow cells in the
prevention of death in swine given an approximate
$LD_{100}/30$ dose of x irradiation was investigated. Clini-
cal, laboratory, and histological studies are reported
on three control and nine marrow-treated swine follow-
ing 550 r total-body x ray. Recovery, as evidenced by
hematological data, is described in one animal still liv-
ing eight months after x-ray exposure and bone-marrow
injection. (auth)

482   HW-59500 (p. 132-4)
General Electric Co. Hanford Atomic Products Opera-
tion, Richland, Wash.
CHINOOK SALMON SPAWNING IN THE VICINITY OF
HANFORD—1958. W. C. Hanson. 3p.

A twelve-year record number of chinook salmon
spawned near Hanford during the fall of 1958. The larg-
est upstream passage of salmon in recent years, elimi-
nation of an Indian fishery, and a deterrent from dam
construction upstream from Hanford are considered the
major influencing factors. (auth)

483   HW-59500 (p. 135-7)
General Electric Co. Hanford Atomic Products Opera-
tion, Richland, Wash.
EFFECTS OF VARIABLE RIVER FLOW ON THE TOX-
ICITY OF REACTOR EFFLUENT. P. A. Olson. 3p.

Toxicity of reactor effluent to young salmon and
whitefish was no greater when the concentration was
varied throughout the day than when the concentration
was held constant. Diurnal fluctuations in river flow
over a 2.5 fold range should not create an effluent tox-
icity problem for Columbia River fish. (auth)

484   HW-59500 (p. 138-43)
General Electric Co. Hanford Atomic Products Opera-
tion, Richland, Wash.
RADIOACTIVE CONTAMINATION IN WILDLIFE.
W. C. Hanson and J. J. Davis. 6p.

Radioactive contamination in terrestrial and aquatic
wildlife in the environs of Hanford Atomics Product
Operation is routinely measured by sampling indicator
organisms. In addition, game species of birds and fish
are sampled during periods when they contain maxi-
mum contamination and when they are available to
sportsmen. During the past three years radioactive
contamination levels in terrestrial organisms have re-
mained comparable and levels in river organisms have
increased slightly. (auth)

485   HW-SA-38
General Electric Co. Hanford Atomic Products Opera-
tion, Richland, Wash.
MONITORING FOR AIR-BORNE RADIOACTIVE MATE-
RIALS AT HANFORD ATOMIC PRODUCTS OPERATION.
J. K Soldat. June 1959. 20p.

Presented at the Air Pollution Control Association
Meeting, Los Angeles, California, June 21-26, 1959.
OTS.

Methods employed at Hanford Atomic Products Opera-
tion to monitor for air-borne radioactive materials are
described. Criteria used to establish the atmospheric

monitoring program include recommendations of the
National Committee on Radioactive Protection, H.A.P.O.
Radiation Protection Standards, amounts and types of
radioisotopes discharged to the atmosphere, and the
meteorology and population density of the plant en-
virons. Fixed and portable instrumentation measures
and records external radiation dosage rates, and/or
collects various types of samples. The samples are
analyzed by radiochemical techniques for both gross
radioactivity and specific radioisotopes. (auth)

486   NP-7964
Chicago. Univ. Air Force Radiation Lab.
RADIATION SCREENING PROGRAM. Summary Report
for period January 15, 1956 through January 15, 1959.
J. Doull, V. Plzak, and S. Brois. 97p.

The purpose of the radiation screening program is to
find chemical compounds which will reduce radiation in-
jury and prevent mortality in irradiated animals. Each
compound submitted for testing is investigated for both
prophylactic and therapeutic activity against radiation
injury in rats and mice. Agents which appear to be
promising in the screening studies are investigated
further using other species, different dosages of x or
gamma radiation, and are also tested for protective
activity against chronic irradiation exposure. Results
are summarized on the radioprotective activity of ap-
proximately five hundred compounds. (C.H.)

487   UCRL-5593
California. Univ., Livermore. Lawrence Radiation
Lab.
THE CONTROL OF BERYLLIUM HAZARDS. Carl L.
Lindeken and Orville L. Meadors. July 15, 1959. 23p.
Contract W-7405-eng-48. OTS.

The toxicological properties of beryllium and com-
pounds of beryllium are briefly reviewed, together with
the historical development of the recommendations for
maximum permissible beryllium air concentrations.
The application of the enclosure technique for the con-
trol of beryllium hazards is described. Emphasis is
placed on the design objectives of partial and total en-
closures and the related function of auxiliary compo-
nents. Monitoring procedures used to evaluate the per-
formance of enclosures are discussed. (auth)

488   UR-555
Rochester, N. Y. Univ. Atomic Energy Project.
FIELD STUDIES OF FISSION PRODUCT INHALATION.
PART III. FISSION PRODUCT FIELD RELEASE TEST
SERIES ONE (FPFRT-I). Robert G. Thomas and
Robert H. Wilson. July 16, 1959. 146p. Contract W-
7401-eng-49. OTS.

Rats and dogs were exposed to clouds of fission prod-
ucts released from the high temperature meltdown of
reactor fuel element in the field. The primary goal of
this biological program was attainment of good lung
deposition values which could be used in the initial step
of the biological counterpart of reactor hazards evalua-
tion. There was a total of seven releases with biologi-
cal participation, three from aged and four from green
fuel elements, and each under various conditions of
lapse or inversion meteorological condition. The chief
biological observations are summarized. In the early
releases, even with the animal sacrifice occurring
shortly after exposure, the gastrointestinal (GI) tract
values obtained were unrealistically high due primarily
to licking. During the course of the Testing Program
the GI tract-to-lung ratios in rats were reduced from
> 30 to < 1 by altering such parameters as exposure,

cage construction, degree of consciousness of animals
during exposure, methods of sacrifice, and time of en-
try into the field for pickup and sacrifice. In both rats
and dogs the median deposition of fission products in
the lower respiratory tract appears to be between 30
and 35% of that amount of material breathed, and the
estimated total deposition appears to be at least 70%.
The fission products released from green fuel elements
may be deposited in the lower respiratory tract some-
what more readily than those from aged elements.
Limited metabolism data from dogs indicate a short ef-
fective half-time of elimination of fission products from
the green elements via the urine, and also via the feces
for the early period post-release. At later times the
effective half-time of elimination of fission products
from the lung increases and consequently the rate of
fecal excretion decreases. The use of fall-out meas-
urements for estimation of body uptake (lung deposition)
can give misleading results unless the individual iso-
topes are well characterized. The external contamina-
tion-to-lung ratios for rats exposed to green releases
(iodine) are 10 times the ratios of those exposed to
aged releases (cesium). (auth)

489   AERE-Trans-830
RADIATION PROTECTION BY FILM BADGE FOR
PERSONNEL WORKING WITH RADIOACTIVE MATE-
RIAL. H. Langendorff and F. Wachsmann. Translated
by E. Franklin (U.K.A.E.A. Atomic Energy Research
Establishment) from Atomkernenergie 3, 60-4(1958)
14p.

This paper was previously abstracted from the origi-
nal language and appears in NSA, Vol. 12, as abstract
No. 6068.

490

STRONTIUM-90 IN FOOD. J. L. Kulp, R. Slakter, and
A. R. Schulert (Lamont Geological Observatory, Pali-
sades, N. Y.). Agri. Food Chem. 7, 466-9(1959) July.

The average concentrations of strontium-90 in U. S.
foods in July 1959, were cereals, 20 S. U.; vegetables,
12 S. U., and milk 8 S. U. The physical aspects of fall-
out, and the manner in which debris produced at the
detonation of thermonuclear devices is transmitted
through the atmosphere to the soil, plants, foodstuffs,
and man are reviewed. The influence of the amount of
rainfall on fall-out levels in the soil is discussed. The
effect of the amount of available calcium in the soil on
transport of strontium-90 into plants is considered.
Other factors affecting levels of strontium-90 in foods
are discussed. It is pointed out that hazards repre-
sented by current rates of strontium-90 from fall-out
have not been completely evaluated. No pathological ef-
fects have been demonstrated at radiation levels as low
as those involved in fall-out. (C.H.)

491

METHOD OF MEASURING RADIOACTIVITY IN BIO-
METEOROLOGY AND HYGIENIC INSPECTION OF THE
SURROUNDING ATMOSPHERE. Vladimir Struzka.
Českoslo. hyg. 3, 203-16(1958). (Translated from
Referat. Zhur. Khim. No. 4, 1959, Abstract No. 12247)

Methods are presented for the direct determination
of radioactivity (R) of the surrounding atmosphere and
methods of indirect determination of R by measurement
of R in growing plants which provide products used in
production of milk, meat, vegetables, and others.
Measurement of the concentration of radiosubstances
in the human is also discussed.

492

REGULATING IONIZING RADIATION. Electronics 32, No. 44, 22-3(1959) Oct. 30.

Legislation governing ionizing radiation in New York State is discussed. The public safety program of Westchester County, New York, in relation to ionizing radiation is described. The results of a survey on faults with medical-dental x-ray equipment are presented. (C.J.G.)

493

ENHANCEMENT OF THE PROTECTIVE ANTI-RADIATION EFFECT OF HYPOXIA BY CYSTEINE AND BENZEDRINE. M. Praslička. Folia Biol. (Prague) 3, 271-81(1957). (In Russian)

Data are tabulated which show enhancement by cysteine and benzedrine of the protective effects of anoxia against radiation injuries in mice and rats. Possible reaction mechanisms involved are discussed. (C.H.)

494

SEMI-TRACTOR FOR TRANSPORTING IRRADIATED U. R. Haguet (Etudes Générales aux Services Nucléaires, St. Gobain, France). Inds. atomiques 3, No. 7-8, 95-6 (1959). (In French)

A semi-tractor arrangement for hauling irradiated U to the processing plant at Marcoule is described. Load positioning, shielding, and other safety factors are discussed. (T.R.H.)

495

HEALTH PHYSICS ASPECTS OF CRITICALITY. H. J. Dunster (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). Nuclear Eng. 4, 343-6(1959) Oct.

The methods of detecting the release of radiation, the identification of exposed personnel, and an estimation of the dose received are reviewed. (C.J.G.)

496

SAFETY TECHNIQUE IN THE EXTENSIVE INTRO-DUCTION OF RADIOACTIVE APPARATUS. G. G. Iordan, T. G. Neyman, and K. S. Furman. Priborostroenie No. 3, 21-2(1959).

It is necessary to issue specialized sanitary regulations for the application of radioactive apparatus with inherent gamma-sources for technological inspection purposes. In places where people are working who are not professionally engaged in work with ionizing radiation, the radiation dose originating from technological inspection apparatus should not exceed one tenth of the maximum admissible radiation dose. If this requirement is to be satisfied in practice, it is necessary to keep the dose rate on the surface of such apparatus below 0.2 microroentgen/second. Formulas for safety clearances are derived and applied to special cases. The safety clearances can also be determined with a dosimeter. It appears to be expedient that the manufacturers of radioactive apparatus should send a team of specialists to customers who will install the equipment in a suitable place. A report is given on the problems involved in transporting such equipment and on its regular inspection. (TCO)

497

AN INTEGRATING DOSE METER. K. Rumyantsev. Radio, No. 10, 36-7(1958).

The design and construction of an intergrating dosimeter, which measures doses of x and γ radiation and automatically switches off x-ray apparatus when the prescribed dose is obtained, is described. An original feature of the dosimeter is the electric pulse amplifier on barium-tupe arc gaps. The advantages of this dosimeter are discussed. An electromagnetic counter is used instead of a needle counter. The receiving device is an ionization counter with a low capacity measuring condenser in its circuit. The barium arc gap is connected to the condenser so that the ionization current charges the condenser, under the influence of radiation, up to the ignition potential of the gap. The strength of the radiations can be gaged from the frequency of pulse succession. A circuit diagram is given. (TCO)

498

RADIATION TO WHICH THE POPULATION IN MEXICO IS EXPOSED. Guillermo Santín (Escuela de Medicina, Mexico City). Rev. mex. radiol. 13, 43-60(1959) Mar.-Apr.

As an introduction to an estimation of the radiation to which the Mexican population is exposed, the effects of radiation on man are reviewed and summarized. The sources of ionizing radiation, divided into avoidable and unavoidable, are discussed. The avoidable sources include nuclear reactors, thermonuclear plants, x-ray apparatus, radioactive luminescent paints, nuclear explosions and fallout, radioactive isotopes, and teletherapy. The unavoidable sources are cosmic radiation and natural radioisotopes in the atmosphere and soil. The results of determination of the background radiation in the Valley of Mexico are tabulated. Radiation exposure in diagnostics and therapy is considered in some detail. (J.S.R.)

499

PROTECTION IN RADIOTHERAPY. COBALT-60 AND CESIUM-137. Ruherí Pérez Tamayo (Escuela Nacional Medicina, Mexico City). Rev. mex. radiol. 13, 61-80 (1959) Mar.-Apr.

The international standards for radiation protection are summarized. The formulas for the calculation of shielding requirements are illustrated with examples of the problems found in the construction of the Departamento de Radioterapia del Hospital Francés. Definitions of the common terms used in discussions of radiation protection are given. (J.S.R.)

500

INVESTIGATIONS ON A BIOLOGICAL RADIATION PROTECTION. XXXII. THE QUESTION OF THE BIOLOGICAL RADIATION PROTECTION AFTER REPEATED WHOLE-BODY IRRADIATION WITH LETHAL RADIATION DOSES. Hanns Langendorff, Hans-Joachim Melching, and Hans-Adolf Ladner (Universität, Freiburg i. B.). Strahlentherapie 110, 34-40(1959) Sept.

In continuation of the studies about the protective effect and the role of 5-hydroxytryptamine on mice exposed to high energy irradiation, a protective effect even after repeated whole-body irradiation with lethal doses was reported. In the discussion possible recovery mechanisms and the development of a possible resistance to irradiation is mentioned. (auth)

501

DO RADIATION SENSITIZATION PROPERTIES BELONG TO 3, 4-BENZPYRENE OR LACTOFLAVIN-5-PHOSPHATE? (ALSO A CONTRIBUTION ON THE EFFECTING OF BLOOD FORMATION BY CANCEROGENIC SUBSTANCES). Ruprecht Koch and Gunter v. Ehrenstein (Universität, Freiburg i. B. and Universität, Stockholm). Strahlentherapie 110, 41-52(1959) Sept. (In German)

Lactoflavin-5-phosphate, administered prior to whole-body x irradiation does not change the sensitivity to radiation of rats. 3−4-Benzpyrene given to rats after irradiation causes a higher lethality at the LD 50, ap parently caused by the summation of two noxious factors. Experiments with Fe^{59} and studies about the behavior of reticulocytes and white blood cells indicate that in the combination of 3−4-benzpyrene plus irradiation, no real sensitization effect is due to benzpyrene. The behavior of the iron metabolism, and more significant the behavior of the reticulocytes, indicates a radio-mimetic effect of the cancerogenic substance. (auth)

502

INVESTIGATIONS OF FOOD AND MILK FOR THEIR CONTENT IN STRONTIUM-90. Ekkehard Groos (Max-Planck-Institut für Biophysik, Frankfurt am Main). Strahlentherapie 110, 66-9(1959) Sept. (In German)

The levels of strontium-90 in cattle food and milk were determined during the period between January and May 1958. The method of determination was described in detail and the results were reported in tables. Milk had its maximum contents of strontium−90 in February, the cause of which could not be explained. After the feeding of fresh grass the contents of stron-tium−90 in milk are increasing steplike. Samples of grass in addition had considerable contents of strontium-89. (auth)

503

THE GENETIC BURDEN OF THE POPULATION IN FLUOROSCOPY IN THE SHOE INDUSTRY. Walter Seelentag and Sumer Pek (Universität, Munich). Strahlentherapie 110, 116-32(1959) Sept. (In German)

German and foreign literature on the subject is surveyed. Data are reported from measurements of radia-tion doses on 10 different shoe fluroscopy machines, dose measurements to the gonads of customers and selling staff, to the feet of customers, and methods for radiation protection of the selling staff. Most of the machines were consisting with the directions of PTB, however some of them had a high dose output. This justifies the demands for closer supervision of these machines. (auth)

504

LABOR HYGIENE IN THE WORK WITH COVERED SOURCES OF GAMMA RADIATION. N. Yu Tarasenko. Trudy Vsesoyuz. Konf. Med. Radiol. Moskov., Medgiz, 11-18(1957). (Translated from Referat. Zhur. Met., No. 8, 1958, p.285).

Possible cases of irradiation by γ sources in the transportation of compounds and in work with apparatus of movable and stationary types were examined. A table of the character of radioactive isotopes used as sources of γ rays is included. (TCO)

505

POCKET-TYPE GAMMA-RADIATION DOSIMETER. M. Aradenne, G. Yeger, B. Isayev, V. Roggenbuk, and G. Froylikh. Vsesoyuz. Sbornik Issledovaniya V Oblasti Dozimetrii Ioniziruyushchikh Izluchenii, Moskov, Akad. Nauk S.S.S.R., 112-14(1957). (Translated from Referat. Zhur. Elektrotekh., No. 2, 1959, p.151).

A pocket-type electrometer with a quartz filament and a reading microscope is described. The electrometer has a linear scale calibrated in milliroentgens. The scale span is 0 to 200 milliroentgens. Thirty experi-mental models of the instrument were tested. The charge leakage never exceeded 5% per day. The reading spread of individual meters did not exceed 10%.

506

ATOMTECHNISCHES AEROSOL UND ATMOS-PHARISCHE RADIOAKTIVITÄT. (Aerosols from Atomic Technology and Atmospheric Radioactivity). M. Hinzpeter, F. Becker, and H. Reifferscheid. No. 7 of "Schriftenreihe des Bundesministers für Atomkern-energie und Wasserwirtschaft. Strahlenschutz." Brunswick, Gersbach and Sohn Verlag GmbH, 1959. 61p. DM 4.

A survey of the behavior of artificial radioactive aerosols in the atmosphere is presented. The monitor-ing of the atmospheric radioactivity by the German Weather Bureau with a discussion of the monitoring sites, the methods, and results obtained is described For a quantitative evaluation of rain-out, wash-out, and fall-out, the meteorological behavior causing precipitation is discussed. The effect of weather on atmospheric radioactivity is also considered. 18 ref-erences. (J.S.R.)

507

KHIMICHESKAYA ZASHCHITA OT DEYSTVIYA IONIZIRUYUSHCHEY RADIATSII. (Chemical Protection from Effects of Ionizing Radiation). Yevgenii Fedoro-vich Romantsev and Vladimirovich Savich Aleksey. Moscow, Medgiz, 1958. 142p.

Principles of biological action of ionizing radiation are presented. Part II. Chemical protection of animals against harmful effects of radiation is examined and a survey of publications concerning this problem is given. Protection with chemical agents was approached by in-vestigation of processes occurring in the organism during radiation, and investigation of chemical com-pounds capable of directing the processes in the organ-ism, and an empirical selection of protective agents. Mechanisms of protective action are discussed. (TCO)

508

NUCLEAR SAFETY. Technical Progress Reviews, Vol. 1, No. 1. W. B. Cottrell, ed. Oak Ridge, Tenn., Oak Ridge National Laboratory, 1959. 53p. $0.55 (GPO).

This review is divided into six sections. In section one nuclear safety criteria are discussed which include: biological and economic considerations, site-selection criteria, safety and experimental systems, and fission-able material outside reactors. Section two is devoted to accident analysis and includes: Simulator studies of reactor accidents, analysis of reactor transients, col-lapse of parallel-plate fuel assemblies, and leak in the Homogeneous Reactor Test core tank. In section three reactor safety features are discussed. These include reactor fuses and reactor safety system design criteria. Section four discusses plant safety factors which include the evaluation of containment systems, structural in-tegrity of containment vessels, and containment vessel leak detection. In the fifth section activity release and consequences are described. These include: activity buildup, fission product release, and environmental monitoring. The last section is devoted to current events. These include nuclear incidents, regulatory role of the Atomic Energy Commission, factors con-sidered in reactor site evaluation, inspection objectives and criteria, license application and actions, and safe-guard reports and bibliographies. (W.L.H.)

509

DIE BERUFLICHE STRAHLENBELASTUNG. (The Occupational Radiation Burden). Hans Dresel. No. 11 of "Schriftenreihe des Bundesministers für Atomkern-

energie und Wasserwirtschaft. Strahlenschutz."
Brunswick, Gersbach and Sohn Verlag GmbH, 1959.
DM 4.

The results obtained from the evaluation of 26,129
film badges sent out from Freiburg in 1957 to medical
clinics, industries, and research institutions using
radiation sources or radioisotopes are presented. The
method of evaluation is described. The results are
tabulated and arranged according to the size of the
operation using radiation, position of person in the
operation, age, sex, and family status of personnel,
and total length of time in occupational exposure to
radiation. (J.S.R.)

ISOTOPE SEPARTION

510   CNI-24
Italy. Comitato Nazionale per le Ricerche Nucleari,
    Milan.
SEPARAZIONE DEGLI ISOTOPI DELL'URANIO. (The
Separation of Uranium Isotopes). P. Caldirola and
R. Fiocchi. Sept. 1959. 169p.

All available information on uranium isotopic separa-
tion from published papers, private communications,
and direct tests and studies is collected. In view of the
fact that the characteristic and essential feature of the
gaseous diffusion process— the only one presently ap-
plied to industrial production— is the preparation of
suitable porous barriers and that to this processing the
greatest part of the research made in Italy has been
devoted, this subject was treated in detail. Other topics
were dealt with mainly to obtain an evaluation of the
various elements which determine the convenience of
building a plant. The probable costs of enriched ura-
nium produced in a possible European plant are also
calculated on the basis of different assumptions. This
report intends essentially to collect in as complete a
fashion as possible all the information presently avail-
able, with the aim to facilitate a possible study for the
construction of a separation plant. (auth)

511   GAT-T-673
Goodyear Atomic Corp., Portsmouth, Ohio.
MODERATING RATIOS AND POISONING RATIOS OF
THE ELEMENTS AND SOME COMPOUNDS. J. L.
Feuerbacher. Sept. 1, 1959. 12p. Contract AT(33-
2)-1. OTS.

Moderating ratio and poisoning ratio are defined and
their significance is explained. Best values of moder-
ating ratio and (where applicable) poisoning ratio are
given in tabular form, first for materials most likely
to be used at the Portsmouth Gaseous Diffusion Plant,
and then for all elements and some compounds. These
values are then illustrated in graphical form. Apparent
anomalies are discussed with reference to extrapolation
distances for unreflected and reflected aluminum and
steel containers, as well as a number of other observa-
tions of interest. Methods of calculation are outlined
and all terms are defined. (auth)

512   ORO-210
Virginia. Univ., Charlottesville. Ordnance Research
    Lab.
THE DEVELOPMENT OF SHORT BOWL ULTRACEN-
TRIFUGES. Progress Report No. 1. Gernot Zippé,
J. W. Beams, and A. R. Kuhlthau. Dec. 1, 1958. 27p.
Contract AT(40-1)-2400. (UVA/ORL-2400-58-PR-1).
OTS.

Russian developments in ultracentrifuges for U iso-

tope separation are described. Progress on develop-
ment of the short-bowl centrifuge is reported. (For
preceding period see ORO-202.) (T.R.H.)

513   AEC-tr-3842
INFINITELY LONG SEPARATING TUBE WITH AN
END-VOLUME. (Das Unendlich Lange Trennrohr Mit
Endbehälter). Alfred Klemm. Translated for Oak
Ridge National Lab. from Z. Naturforsch. 3a, 211-16
(1948). 19p. (Includes original, 6p.). JCL.

The spatial-timely concentration course of a rare
isotope in an infinitely long separating tube with an in-
termixed purpose container with the use of the source
integral is calculated. The distance of the enrichment
into the separating tube is $1.77 \sqrt{D't}$ for $1 \ll \sqrt{D't}$ and
$1.50 \sqrt{D't}$ for $1 \gg \sqrt{D't}$. The theoretical number of
plates (multiplication) is $2w \sqrt{t}/\sqrt{\pi D'}$ for $1 \ll \sqrt{D't}$ and
wt/l for $1 \gg \sqrt{D't}$. In this instance w is the effective
velocity of the countercurrent, D' is the effective diffu-
sion constant, l is the equivalent length of the purpose
container, and t is the time. The magnitude w and D'
are interpreted for the case of the thermal diffusion
method, of the chemical exchange method, and of the
electromigration method. (auth)

514   AERE-Trans-834
ELECTROLYTIC SYSTEMS WITH COLUMNS FOR THE
RECOVERY OF DEUTERIUM BY THE EXCHANGE RE-
ACTION. [PART] I. E. Cerrai, C. Marchetti, M. Sil-
vestri, and S. Villani. Translated by S. Fitzgerald
(U.K.A.E.A. Atomic Energy Research Establishment)
from CISE Report No. 61, Nov. 1958. 30p.

This paper was previously abstracted from the origi-
nal language and appears in NSA, Vol. 13, as abstract
No. 8610.

515
PRODUCTION OF HEAVY WATER. William P. Beb-
bington (E. I. du Pont de Nemours and Co., Aiken,
S. C.) and Victor R. Thayer (E. I. du Pont de Nemours
and Co., Wilmington, Del.). Chem. Eng. Progr. 55,
No. 9, 70-8(1959) Sept.

Engineering details of the Spevack process for the
production of heavy water by dual temperature ex-
change using hydrogen sulfide are reported. Schematic
flow diagrams showing principal towers and liquid flow
paths are given for the Savannah and Dana Plants.
Carbon steel is corroded by H_2S in water, but the iron
sulfide that is formed acts as a protective coating. Al-
though corrosion is very rapid at first, it drops to a
rate so low as to be negligible after about 1000 hr.
Various measures are discussed which reduce this cor-
rosion even further. Dump valves connected to a 400 ft
stack for burning H_2S in event of leakage, elaborate
monitoring systems, gas masks, and all men working in
pairs are all part of the safety program being employed.
Production rates and the economics of both the Dana
and Savannah Plants are reported. (C.J.G.)

516
SECRETS OF LOW-COST HEAVY WATER. R. A.
Labine. Chem. Eng. 66, No. 21, 170-3(1959). Oct. 19.

A flowsheet and a brief description is given of the
Dual-Temperature Process, in operation at the Savan-
nah River, S. C., plant for the production of heavy
water. (W.L.H.)

517
A METHOD OF PURIFYING He³ BY DISTILLATION AT
1°K. E. R. Hanson, H. H. Otsuki, L. Passell, W. H.
Lien, and N. E. Phillips (Univ. of California, Liver-
more). Rev. Sci. Instr. 30, 591(1959) July.

A stainless steel, nitrogen-cooled, vacuum system utilizes copper wool to provide a large cold surface on which the tritium freezes out. Helium-3 gas, originally containing approximately 2.5 parts of tritium in 10^3, was purified to a tritium concentration 7 parts in 10^{11} with two distillations. (C.J.G.)

518

FRACTIONATION OF LITHIUM ISOTOPES BY CRYS-TALLIZATION. A. E. de Vries (F.O.M.-Laboratorium voor Massaspectrografie, Amsterdam). Z. Naturforsch. 14a, 764(1959) Aug.

The fractionation of lithium isotopes by crystallization of lithium compounds from water and organic solutions was observed. The separation factor α,

$$\alpha = \frac{Li^6/Li^7 \text{ (solid)}}{Li^6/Li^7 \text{ (solution)}},$$ is tabulated for LiCl, LiBr, $LiNO_3$, and Li_2SO_4 in water, LiCl in ethanol, and $LiNO_3$ in pyridine. (J.S.R.)

MATHEMATICS AND COMPUTERS

519   AFOSR-TN-59-803

Columbia Univ., New York. School of Engineering.
A DIGITAL-ANALOG CONTROLLER FOR SAMPLED DATA SYSTEMS. Technical Report T-36/B. Stephen C. Bigelow. July 22, 1959. 51p. Project No. 9768. Contract AF 18(600)-677. (CU-56-59-AF-677-EE).

A practical digital controller for sampled data control systems is described. The controller is a hybrid digital-analog computer programmed to solve the control equations. The machine input and output signals are voltage analogs in the range of from -50 to $+50$ volts. Arithmetic operations are performed using analog computer circuits, while storage is accomplished in digital storage registers. Analog-to-digital and digital-to-analog conversions are performed internally. It is believed that this controller serves a twofold purpose: First to demonstrate the feasibility of applying the well-developed theory of sampled data control systems to real processes, and second to provide a useful tool for further study of such systems. (auth)

520   DP-384

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.
IBM 650 ROUTINE IV. SOLUTION OF HEAT DIFFU-SION EQUATION. Richard R. Haefner. July 1959. 70p. Contract AT(07-2)-1. OTS.

A program was prepared for the IBM 650 to obtain the temperature distribution in a section of a tubular heat source. The solution of the heat diffusion equation in (r, θ) geometry is approximated by the solution of a set of appropriate difference equations. Three regions with possible differences in heat conductivity or heat source are allowed in the radial direction, e.g., inner cladding, fuel, and outer cladding. Heat is transferred to a bulk coolant at each radial surface. The program can be used to study the effects of nonbonding between regions and of inhomogeneities in the surface heat transfer and in the heat source. (auth)

521   K-1434

Oak Ridge Gaseous Diffusion Plant, Tenn.
A SMALL MAGNETIC CORE DIGITAL COMPUTER FOR SPECIAL APPLICATIONS (thesis). E. W. Hagen. Oct. 29, 1959. 131p. Contract W-7405-eng-26. OTS.
Submitted to the Univ. of Tenn.
A small externally programmed digital computer

employing static switching elements was designed to reduce specific items of test loop data into operational information for controlling the test. Block diagrams were used to develop the operational philosophy and the various magnetic core circuits. The computer operates in the binary system from an 8, 4, 2, 1 code, and five arithmetic operations have been programmed. The arithmetic routines are such that the decimal equivalent of all numbers in the computations are never less than 0.001 nor greater than 1023.999. Schematic wiring diagrams for the computer sections and sizes of all circuit elements are given. (auth)

522   LAMS-2339

Los Alamos Scientific Lab., N. Mex.
FLOCO II MANUAL. Bengt G. Carlson, Chester S. Kazek, Jr., and Clarence E. Lee. Aug. 1959. 55p. Contract W-7405-Eng-36. OTS.

Floco II is a "load-and-go" type assembly program for use with the IBM 704 calculator. It is a successor to the original Floco system developed in 1956 and described in Los Alamos report T-1-139. During the loading operation all data, remarks, and instructions are assigned core memory space by the assembly program and placed in memory in forms acceptable to the 704. This operation represents a "single-pass" loading and assembly of what one might call the "subject program." The resulting "object program" is therefore ready for immediate execution as soon as the loading is completed. Some information, mostly data, is generated during the execution of the object program. For this the assembly program merely assigns space. Also, in the normal case, one part of the object code is actually executed—the loading process is interrupted—before the rest of the program is loaded and the main execution begun. Many variations on this general theme of alternating between loading and execution are possible. (auth)

523   MND-E-2119

Martin Co. Nuclear Div., Baltimore.
ANPP CODE DEVELOPMENT PROGRAM: PRES-SURIZED WATER TASK; RESULTS OF INITIAL STUDY. ERDL TASK 103, PHASE 3. [1959]. 140p. Contract DA-44-009-ENG-3318.

The required major capabilities of the ANPP Pressurized Water Reactor Code (APWRC), were determined to be automated computation of: (1) reactivity, critical mass, and critical size, (2) reactivity or rod positions during core burnup, (3) transient properties, (4) gross and fine flux, power, and fission product distribution, and (5) parametric-synthetic design of any of these characteristics. Most of the computations performed by APWRC will use one-dimensional syntheses of the multidimensional reactor flux distribution instead of relaxed solutions for these fluxes. APWRC will be a series of specific codes each of which will determine one of the major reactor characteristics listed above. Each code will be compiled from several smaller programs. The sequence of auxiliary calculations necessary for determining each major reactor characteristic is presented in the form of a flow chart. A literature search of presently available digital machine programs was made and the results are included. Approximately 286 programs were catalogued according to their capabilities. The results of the literature search are currently being digested in order to select a specific program for each auxiliary calculation. Several machine programs of interest were run to check them out on The Martin Company IBM 704 Com-

puter and to obtain information necessary before selecting specific programs. Programs which were run include Martin 1D-SN, SNG, SNK, WANDA, CANDLE, and TURBO. An experimental program to support the Code Development Program was initiated and progressed to the advanced planning stage. Initially critical experiments on a series of clean cores with varying boron loading and metal-to-water ratio will be conducted. In addition, experiments will be performed to determine critical rod-bank position and total core reactivity for certain selected cores.

524   MURA-497

Midwestern Universities Research Assn., Madison, Wis.

CONCERNING THE $\nu/N \to 1/3$ RESONANCE. V. ANALYSIS OF THE EQUATION $(d^2v/ds^2) + (2\nu/N)^2 v - b/2 (\cos 2 s) v^2 - \lambda [\cos (2 s/3)] = 0$. L. Jackson Laslett and Seymour J. Wolfson. Aug. 17, 1959. 40p. OTS.

An analytic and computational study was made of the equation given in the title, specifically for the fixed points in the case $\nu/N = 0.3$, $b = 1.15$, and λ usually equal to 0.006. The equilibrium orbits and the fixed points are found to be obtainable quite accurately by a variational method or by use of harmonic balance if a numerical solution of the simultaneous algebraic equations for the coefficients of the trial function is performed. A straightforward application of the Moser procedure is seen to involve as a first step the elimination of the stable forced equilibrium motion—as is given by the appropriate trial-function solution—and the new differential equation is then found to involve an s-dependent (A-G) coefficient for the linear term. The solution is carried through, by continuation of the Moser method to the same order as in previous reports of this series, aided where appropriate by numerical work for the particular example considered. An alternative, and considerably simpler, analytic method similar to the Moser procedure is also examined and is found to lead to results of reasonable accuracy without requiring extensive numerical work. The method also permits estimation of the critical value of λ at which the stable fixed point and one of the unstable fixed points become coincident. (auth)

525   NYO-2545

New York Univ., New York. Atomic Energy Commission Computing and Applied Mathematics Center.

EXACT AND ASYMPTOTIC SOLUTIONS OF THE CAUCHY PROBLEM. Donald Ludwig. Sept. 9, 1959. 96p. Contract AT(30-1)-1480. OTS.

The Cauchy problem for linear hyperbolic equations or systems with variable coefficients is treated. The main problems considered are the propagation of singularities, focusing of singularities, and the construction of fundamental solutions. The methods which are employed correspond closely to the methods of geometrical optics and related fields. (auth)

526   ORNL-2727

Oak Ridge National Lab., Tenn.

THE ORNL FOUR-LINEAR-ELEMENT PACKAGE ANALOG COMPUTER (FLEPAC) INSTRUCTION MANUAL. F. P. Green. Oct. 27, 1959. 31p. Contract W-7405-eng-26. OTS.

A single-package analog computing device has been developed at ORNL and has been named the FLEPAC. The device consists of a power supply and four chopper-stabilized high-gain d-c amplifiers such as are used in large analog computer installations. The amplifiers are commercially available. This package, the ORNL FLEPAC, is described briefly. Instructions for using the device in conjunction with other equipment as well as by itself are given. What is considered a minimum amount of theory of the operation of the direct-coupled amplifier as a computer is also given for persons interested in a basic understanding of the device. (auth)

527   ORNL-2734

Oak Ridge National Lab., Tenn.

GENERALIZED HEAT CONDUCTION CODE FOR THE IBM-704 COMPUTER. T. B. Fowler and E. R. Volk. Oct. 30, 1959. 54p. Contract W-7405-eng-26. OTS.

A generalized heat conduction code, GHT, has been written as an IBM-704 code. This code solves steady-state and/or transient heat conduction problems in three-dimensional geometry. The method used in GHT is numerical integration of the appropriate finite-difference equations. Boundary temperatures and heat generation may be a function of position and/or time. Material properties and film coefficients may be considered as a function of position but are assumed constant with respect to temperature and time. The number of nodal points is limited to 950, which includes internal and boundary points. All boundary points, however, which have the same temperature-time relationship may be considered as one point. The number of neighbors which may affect a given point must be equal to or less than 8. One less tape unit (reserved for input data) is required if all input is from cards. Use of GHT is illustrated by means of a sample problem. (auth)

528   UCRL-5462

California. Univ., Livermore. Lawrence Radiation Lab.

THE SATELLITE CODE: A NUMERICAL SATELLITE INTEGRATION PROGRAM FOR THE IBM 704. Virginia S. Smith, Hans R. Bruijnes, and Nevin W. Sherman. June 1959. 46p. Contract W-7405-eng-48. OTS.

The Satellite program is a general numerical integration routine which is suitable for integrating the motion of satellites and space probes. The equations of motion may include the effects of a model atmosphere, equatorial bulge, up to five perturbing bodies, and thrust. (auth)

529   CEA-tr-A-326

MÉTHODE D'ITÉRATION EN ESCALIER ET MÉTHODES APPARENTÉES POUR LA RÉSOLUTION DES PROBLÈMES AUX VALEURS PROPRES. (Step Method of Iteration and Apparent Methods for the Resolution of Problems at the Characteristic Values). F. L. Bauer. Translated into French by R. Pfeiffer from Z. angew. Math. u. Phys. 8, 214-34(1957). 29p.

Methods are discussed which depend on the behavior at the limit of certain series satisfying Bernouilli difference equations. Step-iteration and convergent bi-iteration are independent of the particular choice of B and C and do not require a good initial approximation. They are stable and self-correcting; the calculations are largely cyclic (series of A and B calculations). These methods are especially adaptable to computers. (T.R.H.)

530   SCL-T-279

THE DETERMINATION OF THE NUMBER OF INDIVIDUAL VALUES NECESSARY FOR A REPRESENTATIVE MEAN VALUE. (Über die Bestimmung der für

Einen Repräsentativen Mittelwert Notwendigen Anzahl
von Einzelwerten). H. Bochow, W. Höhne, and
A. Raeuber. Translated by Marcel I. Weinreich (Sandia
Corp.) from Angew. Meteorol. 3, No. 6, 170-3 (1958).
10p. JCL.

A diagram is presented according to which the num-
ber of individual values necessary for obtaining a rep-
resentative mean value can be estimated on the basis of
a spot check (random sample) taken among n individual
values. It is presupposed that the maximally permissi-
ble deviation from the actual mean value of the collec-
tive should not exceed an assumed value with a high
probability P. (auth)

531

A CURRENT INTEGRATOR WITH DIGITAL OUTPUT.
C. Daum (Instituut voor Kernphysisch, Onderzoek,
Amsterdam). Nuclear Instr. and Methods 5, 75-7 (1959)
Aug.

A proposal to integrate currents larger than 1 μa by
utilizing their magnetizing action is discussed. The
method eliminates the usual integrating capacitor with
the associated leakage and soakage problems and gives
the value of the collected charge in digital form. (auth)

METALS, CERAMICS, AND MATERIALS

General and Miscellaneous

532   AD-211054
Rensselaer Polytechnic Inst., Troy, N. Y.
NIOBIUM SPACE MATERIALS. Progress Report No. 5
for the period ending October 18, 1953. F. V. Lenel,
T. Myhre, and L. J. Regitz. 22p. Contract NOas-57-
739-d.

The investigation of niobium base materials into
which fine particles of refractories were dispersed was
continued. The causes and sources of interstitials pick-
up were investigated and on the basis of information
gained, modifications were made in the powder hydrid-
ing step as well as in the ballmilling and compacting
steps. These include reducing leak rates in the vacuum
systems, exclusion of oxygen and nitrogen from the
atmospheres of various operations, and reduction of
time and temperature for each operation. Processing
of niobium is described with emphasis on filtering and
drying, vacuum dehydriding, and extrusion. Flowsheets
and apparatus diagrams are included. (J.R.D.)

533   AD-216830
Carborundum Co. Research and Development Div.,
Niagara Falls, N. Y.
DEVELOPMENT OF ULTRA REFRACTORY MATE-
RIALS. Progress Report No. 17 [for] February 1
through April 30, 1959. Peter T. B. Shaffer. May 15,
1959. 19p. Contract NOrd-17175.

The principal objective of this work is to secure
basic information on refractory systems from which
may be developed materials suitable for use in air at
temperatures in excess of 1930°C for periods up to one
hour. Development of equipment including a furnace in
which moduli of rupture can be measured, inert atmos-
phere dilatometer, pressurized furnace, and oxidation
furnace is described. Preparation, oxidation testing,
and thermal shock testing of specimens are discussed.
Materials investigated include $ZrB_2 - Zr_5Si_3$, $ZrSiO_4 -$

ZrB_2, $ZrB_2 - MoSi_2$, and $ZrB_2 - WSi_2$. [See also AD-
200603.) (W.D.M.)

534   AECD-4254
[Westinghouse Electric Corp. Atomic Power Div.,
Pittsburgh].
FISSION PRODUCT RELEASE: A COMPARISON BE-
TWEEN UNCLAD METAL FUEL AND CLAD PLASTIC
FUEL. G. F. Bogar and G. R. Hopkins. Aug. 1956.
Decl. with deletions May 6, 1957. 25p. OTS.

In order to estimate the level of air contamination to
be expected in the vicinity of a critical using unclad
U^{235}-Zr fuel, an experiment was designed to compare
this unknown contamination level to the level in the
vicinity of criticals using plastic fuel tape. Results
indicate that the air activity in the vicinity of an oper-
ating critical using unclad metal fuel is lower by a
factor of 100 than the air activity in the vicinity of an
operating critical using plastic fuel. After shutdown,
when the contamination level in the vicinity of the plas-
tic fuel critical rises, the results predict a contamina-
tion level due to the metal fuel critical to be lower by
approximately a factor of 1000. (auth)

535   AECU-4368
Bureau of Mines. Reno Metallurgical Research Center,
Nev. and Bureau of Mines. Boulder City Metallurgy
Research Lab., Nev.
ELECTROCHEMICAL STUDIES OF HAFNIUM, ZIRCO-
NIUM AND YTTRIUM. Quarterly Progress Report No.
8 [for] April 1, 1959 to June 30, 1959. 8p. Contract
AT(11-1)-475. OTS.

Hafnium refining studies were conducted using a
newly designed hot top cell and a standard laboratory
cold top cell, however, metal of adequate purity for use
in assessment of these cells was not produced. Prepa-
ration of K_2HfF_6 for use as electrolyte is described.
The softest metal produced in Hf electrorefining had a
hardness of 42 Rockwell B; the average feed was 58 R_B.
Cathode deposits of the metal were vacuum distilled to
remove adherent salts. Data on the effects of voltage
on the purity of refined yttrium are tabulated. (J.R.D.)

536   AECU-4372
Bureau of Mines. Electrometallurgical Experiment
Station, Boulder City, Nev.
ELECTROCHEMICAL STUDIES OF HAFNIUM, ZIRCO-
NIUM AND YTTRIUM. Quarterly Progress Report No.
7 [for] November 1, 1958 to March 31, 1959. 14p. Con-
tract AT(11-1)-475. OTS.

Electrorefining experiments were conducted using
molten NaCl + KCl electrolyte containing 10% Hf as
$HfCl_4$. It was possible to maintain the soluble Hf content
at $8\frac{1}{2}$ to 10% in the hot top cell, however, no metal was
produced having a hardness of less than 170 BHN. In
cold top cell experiments the soluble Hf content varied
but gradually decreased to less than 1%. Metal having
hardnesses of 145 to 165 BHN was consistently produced
with the lowest being softer than 140 BHN. Investiga-
tions of electrorefining in fused salts are continuing.
Cell tests in which 99.8% Y metal was used produced
deposits containing lower levels of all impurities ex-
cept Mg. The removal of entrained salts from the
electrodeposits is being investigated. (J.R.D.)

537   AECU-4410
Stevens Inst. of Tech., Hoboken, N. J. Powder Metal-
lurgy Lab.
[UO₂ BEARING FUEL PLATES]. Progress Report for
September 1, 1959 through September 30, 1959.

Gregory J. Comstock. Oct. 22, 1959. 7p. Contract AT(30-1)-2258. OTS.

Test results from tensile investigations of UO_2 bearing stainless steel specimens are reported tabularly. The data indicate that the tensile properties of straight stainless steel plates made by slip casting a core plate, cladding by slip spraying and densified by sintering and rolling are comparable to the properties of conventionally fabricated stainless steel. Basic investigation in particle blending is reported and properties of various blends are tabulated along with data on slips produced from these blends and cast sintered cylinders. Slip stability tests are also reported. (J.R.D.)

538 AERE-Bib-119

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
LIST OF PUBLISHED PAPERS AND UNCLASSIFIED REPORTS BY MEMBERS OF THE METALLURGY DIVISION, A.E.R.E., ISSUED OR DECLASSIFIED SINCE JUNE 1957. P. J. Jones, comp. Aug. 1959. 20p. BIS.

A bibliography of 145 published papers and unclassified reports issued or declassified since June 1957 is presented. The reports are by members of the Metallurgy Division and are arranged alphabetically by author within each subject group. (J.E.D.)

539 AFOSR-TR-59-97

Litton Industries. Space Research Labs., Beverly Hills, Calif.
RESEARCH PROGRAM ON HIGH VACUUM FRICTION. Final Report 2907. Siegfried Hansen, W. Jones, and A. Stephenson. Mar. 30, 1959. 148p. Contract AF49 (638)-343.

A study of surface friction under conditions of high vacuum (10^{-5} to 10^{-6} mm. Hg) has been carried out. The program consisted of two phases. The first phase dealt primarily with preparations necessary to carry out the experimental effort. The second phase was devoted to the methodical examination of the friction characteristics of a large group of materials. The principal test condition studied was that of the linear motion between two dry, clean, unlubricated, flat surfaces. In addition to the measurement program, effort was devoted to the study of the microscopic nature of the actual surface-to-surface contacts. Examination of the results of a single sliding contact between two clean, machined surfaces led to the conclusion that each individual contact area was largely point-to-plane. Subsequent point-to-plane studies produced some extremely interesting results. It was found that models could be loaded to yield pressures, and under certain conditions could be made to slide with abnormally low friction forces and without microscopic evidence of wear or surface distortion. This work indicated the existence of two modes of contact, one of pure sliding and a second of areas undergoing shear. The low-friction, low-wear examples appear to be special cases wherein almost all contact areas are of the first type. A theory of friction has been postulated, based principally on the analysis of these tests. During the friction experiments, various trends of the results stimulated consideration of related phenomena and their relationship to the general problem. Several miscellaneous studies were undertaken during the program, and these are also reported where significant. (auth)

540 BM-IC-7933

Bureau of Mines.
STRONTIUM. A Materials Survey. Albert E. Schreck and Joseph C. Arundale. 1959. 49p.

A report on the uses, properties and substitutes for strontium is presented. The mineralogy and geology of this element are set forth along with techniques used in mining, milling, and processing. In addition, information on the domestic supply is given as well as data on world production and trade. (J.R.D.)

541 BMI-726(Del.)

Battelle Memorial Inst., Columbus, Ohio.
PROGRESS REPORT FOR THE MONTH OF JANUARY 1952. H. W. Russell, H. R. Nelson, and R. W. Dayton. Feb. 1, 1952. Decl. with deletions Apr. 18, 1957. 48p. Contract W-7405-eng-92. OTS.

Studies of the effect of body variables on the resistance of sintered BeO to thermal fracture are reported. Postirradiation measurements on graphite fuel structures containing enriched U are in progress. The compound $3Nb_2O_5 \cdot ZrO_2$ was formed by sintering mixtures of the oxide powders and some strength properties were determined. High-density graphite compacts were prepared. Creep and dimensional stability studies of U are continuing. Methods of roll-cladding U and U-Cr alloys with Zr are being developed Additional bending fatigue data on Th sheet are reported. Roll-cladding of Th with Zr, Ti, and stainless steel is being studied. Creep tests on Sn-Zr alloy are being made. Corrosion studies on Sn-Zr alloys are reported. High-temperature creep tests of 2S Al are continuing. Work is continuing on the preparation of pure metal sulfides for use as solvents for U compounds. Corrosion studies on Ni are reported. (W.L.H.)

542 CTR-373

Office of Technical Services, Washington, D. C.
CERAMICS AND REFRACTORIES (INCLUDES COATINGS: CERAMIC, ENAMEL AND REFRACTORY; HIGH TEMPERATURE AND ELECTRICAL PROPERTIES OF CERAMICS; CERAMICS AND REFRACTORIES, GENERAL, 1930-59). Catalog of Technical Reports. 22p. OTS.

A bibliography is presented on ceramic and refractory materials that includes coatings: ceramic, enamel, and refractory, and high temperature and electrical properties of ceramics. (W.L.H.)

543 HW-55912

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
BOND TESTING ZIRCALOY CLAD COEXTRUDED FUEL ELEMENTS. T. G. Lambert. Apr. 30, 1958. Decl. Sept. 29, 1959. 6p. OTS.

A study was made to determine if bond testing is required for Zircaloy-clad fuel element, and methods for performing the test operation are discussed. Test results are tabulated. (auth)

544 KAPL-M-GFM-8

Knolls Atomic Power Lab., Schenectady, N. Y.
REPORT ON THE EVALUATION OF BP-85 INCONEL-TYPE COVERED ELECTRODE. G. F. McKittrick and W. A. Owczarski. June 26, 1959. 18p. OTS.

The development and production of a new Inconel-type covered electrode capable of meeting higher quality standards required for radioactive system service were undertaken. This electrode is intended for welding Inconel to itself, Inconel to dissimilar metal, and carbon steel overlaying. Results from an evaluation of the BP-85 are summarized. (W.D.M.)

545 KAPL-M-HOS-9

Knolls Atomic Power Lab., Schenectady, N. Y.
SHOT PEENING FOR PROTECTION AGAINST STRESS CORROSION CRACKING. Henry Suss. Sept. 18, 1959. 15p. OTS.

Shot peening, when properly incorporated into a specific product design and effected by a properly designed and controlled process, will protect hardened (RC 36-42) AISI 410 stainless steel from stress corrosion failure in high purity waters at temperatures up to 300°F for a useful finite period at stresses up to 60,000 psi, and indefinitely at stresses up to approximately 45,000 psi, about one-third of the yield strength. Before shot peening is used for protection against stress corrosion attack, consideration must be given to the effects of the environment, anticipated stresses, and temperature of application on the fadeout of the surface residual layer. For most applications there should not be any problem in establishing adequate process and quality control procedures. The basic data developed on shot peening of AISI 410 could be made applicable to other susceptible alloys as means for protection against stress corrosion attack. (auth)

546   NP-7928

Mallory-Sharon Metals Corp., Niles, Ohio.
THE ELECTRON BEAM MELTING OF BERYLLIUM, BORON, BORON CARBIDE, TANTALUM CARBIDE, TITANIUM CARBIDE, TUNGSTEN, AND ZIRCONIUM DIBORIDE. Quarterly Progress Report No. 1. Charles B. Dittmar and Stanley Abkowitz. July 1958. 9p. Contract AF33(616)-5603.

The advantages of electron gun melting are outlined. It was observed that titanium carbide could not be satisfactorily melted by electron gun melting process due to the vaporization of titanium. (J.E.D.)

547   NP-7948

Brush Beryllium Co., Cleveland.
PRODUCTION OF BERYLLIUM SHEETS FINISHED FLAT TO GAUGE. PHASE III—PHASE IV. Progress Report No. 7 [for] May 1 to July 31, 1959. K. G. Wikle and J. W. Armstrong. 43p. Contract AF33(600)-35829.

Preliminary work on the hot clad rolling of 24-inch-wide by 60-inch-long light-gauge beryllium sheet is described. Further information on hot slitting, shearing, leveling, sawing, and grinding is reported. Uniformity of tensile properties in Phase III sheet hot rolled from vacuum-hot-pressed −325 mesh recycle powder is statistically presented, and the results of elevated-temperature testing are listed. The effects of various post-rolling treatments are discussed, and the initial work on low reduction sheet is described. (auth)

548   NYO-2684

Olin Mathieson Chemical Corp. Metallurgical Labs., New Haven.
NUCLEAR FUEL RESEARCH LABORATORIES FUEL CYCLE DEVELOPMENT PROGRAM. Quarterly Progress Report No. 1 [for] period ending September 30, 1959. Oct. 19, 1959. 39p. Contract AT(30-1)-2374. OTS.

Under Task I a process for the fabrication of uranium oxide fuel pellets by an inert atmosphere low temperature sintering temperature is being developed. The process consists of an initial oxide air roasting pretreatment to introduce excess oxygen into commercial ceramic grade oxide, followed by granulation, pressing, and sintering. Oxidation rates, O/U ratios, wet ball milling, and roasting procedure were studied. The major effort on Task II was directed toward the development of a good method for the production of uranium monocarbide. These efforts were channeled in three directions, the arc melting of the component materials, the reaction of methane with uranium hydride, and the reduction of UO_2 with carbon. (W.D.M.)

549   NYO-2735

Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.
THE DEVELOPMENT AND TESTING OF THE UO_2 FUEL ELEMENT SYSTEM. PROGRESS REPORT FOR PERIOD MAY 15—AUGUST 31, 1959. C. E. Burdg, G. W. Cartier, B. E. Murtha, and G. C. Robinson. 58p. Contract AT(30-1)-2379. OTS.

The purpose of the program is to reduce the fuel cycle cost for the bulk UO_2, metal clad (stainless steel or Zircaloy-2) fuel element system through the development and testing of various potentially lower cost design concepts and fuel element and fuel element cluster fabrication procedures. The various potentially lower cost design concepts and fabrication techniques being considered are described. Phase I (6 months) is concerned with screening the various concepts on the basis of cost and feasibility in order that those concepts offering the most promise for meeting the over-all objective may be selected for further development and testing. The potential cost saving offered by each concept is being estimated utilizing the APWR conceptual design as a basis for comparison. A limited experimental effort is underway to demonstrate technical feasibility in those areas where existing technology must be substantially expanded. (auth)

550   UCRL-5705

California. Univ., Livermore. Lawrence Radiation Lab.
CURRENT BERYLLIUM LITERATURE; A SELECTED BIBLIOGRAPHY, JANUARY 1958—AUGUST 1959. Zanier D. Lane. Sept. 29, 1959. 33p. Contract W-7405-eng-48. OTS.

This bibliography lists selected articles on beryllium which have appeared in journals received in the library of the Lawrence Radiation Laboratory, Livermore, California, and articles, reports, and books which have appeared in the following abstracting services between January, 1958 and August 1959; Metallurgical Abstracts, U.S. Library of Congress Monthly List of Russian Accessions, Nuclear Science Abstracts, and A.S.M. Review of Metal Literature. Sources for the references are noted in parentheses at the end of entries in the bibliography. (auth)

551   USBM-U-550

Bureau of Mines. Northwest Electrodevelopment Experiment Station, Albany, Oreg.
QUARTERLY METALLURGICAL PROGRESS REPORT NO. 1 FOR THE PERIOD OF OCTOBER 1, 1958 TO DECEMBER 31, 1958. 36p. Contract AT(11-1)-599. OTS.

Yttrium metal has been prepared by reducing yttrium chloride with purified lithium. The metal can be cold-rolled 95% without intermediate annealing. A method is presented for the preparation of six-kilogram lots of high purity thorium chloride. Preparation for the conversion of uranium hexafluoride to metal includes a literature survey and the construction of a laboratory. A semi-continuous laboratory-scale reactor has been constructed for the reduction of zirconium and hafnium chlorides. The experimental work on heat transfer in air-cooled melting crucibles is essentially complete. The preliminary study of crucible coolants other than water is complete. A study is being started on the distribution and dispersion of radioactive isotopes which occur during the melting of thorium and uranium, with special emphasis on their relation to personnel safety. The study of expendable molds for the casting of reac-

tive metals is continuing. Preliminary melts have been prepared for the establishment of phase diagrams of the Zr-Sm and Zr-Gd systems. The proposed Hf-Ni phase diagram is being re-examined in order to verify certain tentative values. Dynamic fused-salt scrubbing of hafnium tetrachloride successfully reduces the aluminum content from 1200 to 350 ppm. Analytical methods are being investigated for the identification of trace impurities in hafnium. A tentative diagram for the zirconium-dysprosium system has been prepared. (auth)

552 WCAP-1245

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

THERMOELECTRIC NUCLEAR FUEL ELEMENT. First Quarterly Report. July 10, 1959. 34p. Contract AT(30-3)-500. OTS.

Thermoelectric measurements were completed on the materials $Li_{0.013}Ni_{0.987}O$ and $Li_{0.035}Ni_{0.965}O$, $La_{0.1}Ba_{0.9}TiO_3$, $Bi_{0.05}Ge_{0.95}Te$, GeTe, $Na_{0.05}U_{0.95}O_2$, MnTe, and CeS_x. On the basis of the present data, all materials have sustained radiation damage at the temperatures of exposure in the reactor. The radiation damage begins to anneal out for most materials at fairly low temperatures as shown by the post-irradiation measurements. (auth)

553 WCAP-1317

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

THERMOELECTRIC NUCLEAR FUEL ELEMENT. Second Quarterly Progress Report. J. C. Danko, A. Biancheria, G. R. Kilp, P. J. McCoy, and S. W. Sandberg. Oct. 10, 1959. 25p. Contract AT(30-3)-500. OTS.

Samples of the following thermoelectric materials were prepared for irradiation studies during this report period: $Li_{0.05}Ni_{0.95}O$, GeTe, $Bi_{0.05}Ge_{0.95}Te$, $La_{0.1}Ba_{0.9}TiO_3$, $Na_{0.05}U_{0.95}O_2$, ZnSb, and $CeSe_x$. In-pile measurements of the Seebeck coefficient and electrical resistivity were made on the following materials: $Li_{0.05}Ni_{0.95}O$ (at ~450°C), GeTe (reactor ambient ~200°C and at ~450°C), PbTe (at ~500°C), and Bi_2Te_3 (reactor ambient ~200°C). Pre- and post-irradiation experiments have been performed on the following thermoelectric materials: $La_{0.1}Ba_{0.9}TiO_3$, $Bi_{0.05}Ge_{0.95}Te$, $Na_{0.05}U_{0.95}O_2$, GeTe, PbTe, and ZnSb. With the exception of the PbTe and ZnSb, the above materials have been returned from Brookhaven National Laboratory and post-irradiation measurements are presently being conducted. The results of the irradiation experiments on thermoelectric materials to date indicate that annealing of irradiation damage does occur. Currently planned experiments in a higher flux reactor (10^{14} nv) will determine the extent of radiation damage to the thermoelectric properties and the effect of annealing on the damage. These results should yield important information on the feasibility of the thermoelectric direct-conversion reactor. (auth)

554 NP-tr-286

JOURNAL OF INORGANIC CHEMISTRY. Translation of Zhur. Neorg. Khim. 3, 553-693(1958). Contains Papers and Discussions of a Conference on the Study of Phase Diagrams of Metallic Systems, held May 17-21, 1957, at Moscow. 483p. OTS.

Papers from a conference on phase studies of metallic systems, held 17-21 May, 1957, at the Institute of Metallurgy, Academy of Sciences, Moscow, are included. Separate abstracts have been prepared for eleven papers. (D.E.B.)

555 NP-tr-286(p.166-73)

X-RAY STRUCTURAL ANALYSIS OF CERTAIN SYSTEMS OF TRANSITION METALS. Ye. Ye. Cherkashin, Ye. I. Gladyshevskii (Gladyshevskiy), P. I. Kripyakevich, and Yu. B. Kuz'ma. 8p.

Certain alloys in the systems Mn—Be, Cr—Be, V—Be, Mo—Be, W—Be, Ta—Be, Nb—Be, Mn—Fe—Si, Mn—Fe—Sn, Mn—Co—Si, Mn—Co—Ge, Mn—Co—Sn, Mn—Ni—Si, Mn—Ni—Ge, Mn—Ni—Sn, Mn—Cu—Si, Zr—V—Ni, Zr—Cr—Ni, Zr—Mn—Ni, Zr—Fe—Ni, Zr—Co—Ni were investigated by the x-ray structural method. In these systems we found the following new compounds existing at 400°C: $MnBe_2$ (at t = 1100°C, composition $MnBe_{3 \to 12}$, type $MgCu_2$); $CrBe_{12}$ ($ThMn_{12}$); VBe_{12} ($ThMn_{12}$); $NbBe_2^*$; $NbBe_5^*$; $NbBe_{12}$ ($ThMn_{12}$); $MoBe_{12+x}^*$; WBe_{12+x}; Co_2MnSi (CsCl); $Mn_2Co_3Si_2^{**}$ ($MgZn_2$); $MnCoSi^*$; $Mn_{12}Co_3Si_5^*$; $Mn_3Ni_3Si_2^{**}$ ($MgZn_2$); $MnNiSi^*$; Co_2MnGe (Cu_2MnAl); Ni_2MnGe^* (Cu_2MnAl); Co_2MnSn^{**} (Cu_2MnAl); Ni_2MnSn^{**} (Cu_2MnAl); $ZrMnNi^{**}$ ($MgCu_2$); $ZrV_{0.5}Ni_{1.5}$ ($MgCu_2$). Compounds of tetragonal structure in the systems Mo—Be, W—Be, and Ta—Be, whose formulas have not yet been established, are of the composition $MoBe_{12}$, WBe_{12}, and $TaBe_{12}$ and belong to the $ThMn_{12}$ type. The following ternary solid solutions were found: a) in the system Mn—Fe—Si: between Mn_3Si and Fe_3Si (continuous series of solid solutions); b) in the system Mn—Co—Si: Co and Si in β—Mn, Co in MnSi, Co in MnSi; c) in the system Zr—Fe—Ni: Ni in $ZrFe_2$; d) in the system Zr—Co—Ni: Ni, in $ZrCo_2$. (auth)

556 NP-tr-286(p.210-16)

STUDY OF THE BINARY SYSTEMS Ni_3Ti—Ni_3Ta; Ni_3Ti—Ni_3Nb. I. I. Kornilov and Ye. N. Pylayeva. 7p.

Phase diagrams are presented for the systems Ni_3Ti—Ni_3Ta and Ni_3Ti—Ni_3Nb. These phase diagrams were constructed on the basis of a study of the alloys, using thermal analysis, microstructure, and study of the properties of the alloys: resistivity, hardness, and specific gravity. (W.L.H.)

557 NP-tr-286(p.243-50)

STUDY OF ALLOYS OF THE TERNARY SYSTEM NICKEL—ALUMINUM—TUNGSTEN. P. B. Budberg. 8p.

Alloys of the ternary system Ni—Al—W, with an Al content up to 30% and a W content up to 60%, were studied. The method of thermal analysis was used to construct part of the melting diagram of the binary system Ni—Al—W and to show the eutectic character of their interaction, with formation of a limited solid solution of W in NiAl. The microstructural method was used for determining the boundaries of the phase region in the investigated part of the system, as functions of the temperature. The isothermal sections of the system were constructed at 1200, 1000, and 800°C. (W.L.H.)

558 NP-tr-286(p.251-64)

STUDY OF THE SYSTEM Ni—Cr—NiAl. I. I. Kornilov and R. S. Mints. 14p.

Phase studies are presented of the system Ni—Cr—NiAl. Also investigated were hardness, microstructure, and resistivity of the alloy. (W.L.H.)

559 NP-tr-286(p.265-78)

INTERACTION OF TITANIUM CARBIDE WITH A SIX-COMPONENT NICKEL SOLID SOLUTION. N. I. Kornilov, L. I. Pryakhina, O. V. Ozhimkova, and A. Ya. Snetkov. 14p.

The possibility of studying multicomponent metallic systems by the method of reducing them to equilibrium between a limited number of phases, was demonstrated.

The alloys of the Ni solid solution with TiC have a eu-
tectic character of crystallization, resembling alloys of
the system Ni – TiC. The solubility of TiC in six-
component Ni solid solutions was determined at 1300°C,
this is 1.9% TiC. With decreasing temperature, the
solubility of TiC decreases and is, respectively, 1.4%,
0.55%, and 0.15% TiC at 1250, 1200, and 1000°C. The
existence of only two phases was established: the γ-
solid solution with a Ni base, and a phase based on TiC,
in the alloys of the pseudobinary system studied (γₛ –
TiC). (W.L.H.)

560   NP-tr-286(p.279-86)
STUDY OF METALLIC COMPOUNDS IN A NICKEL-
BASE MULTICOMPONENT ALLOY. R. B. Golubtsova
and L. A. Mashkovich. 8p.

An investigation was conducted of the metallic com-
pounds separated from a Ni-base multicomponent alloy
of one composition. The number of components in the
alloy was nine. The data of the microstructure of the
alloy obtained are characterized by the presence of
three phases: the base, a γ–nickel solid solution; a
metallide phase; and a carbide phase. (W.L.H.)

561   NP-tr-286(p.345-55)
PHASE DIAGRAMS OF ALLOYS OF LANTHANUM
WITH CERIUM, AND LANTHANUM WITH CALCIUM.
E. (Ey.) M. Savitskii (Savitskiy) and V. F. Terekhov.
11p.

Thermal analysis, microstructure, hardness tests,
and resistivity measurements were used to construct
phase diagrams of La–Ce and La–Ca. It was estab-
lished that La and Ce are mutually soluble, both in the
liquid and solid states, and form a diagram with unlim-
ited solubility. In the system La–Ca, a large region of
layer formation in the liquid state was observed, extend-
ing at the monotectic temperature of 760 to 765°C, from
12 to 15 to 90% Ca. The solubility of La in Ca and of Ca
in La at the eutectic temperature of 750°C does not ex-
ceed 3 to 5%. (W.L.H.)

562   NP-tr-286(p.377-88)
STUDY OF THE PHASE DIAGRAMS OF THE ALLOYS
TITANIUM–CHROMIUM, TITANIUM–TUNGSTEN, AND
TITANIUM–CHROMIUM–TUNGSTEN, PREPARED BY
THE METHOD OF POWDER METALLURGY. Yu. A.
Bagaryatskii (Bagaryatskiy), G. I. Nosova, and T. B.
Tagunova. 12p.

Powder metallurgy alloys of Ti–Cr, Ti–W, and Ti–
Cr–W, prepared by the calcium hydride method, were
studied. (W.L.H.)

563   NP-tr-286(p.390-405)
STUDY OF EQUILIBRIUM DIAGRAM OF TITANIUM–
CHROMIUM–ALUMINUM. I. I. Kornilov, V. S.
Mikheyev, and T. S. Chernova. 16p.

On the basis of data on the study of the microstruc-
ture of Ti–Al–Cr alloys in the quenched and annealed
states, phase diagrams were constructed on five iso-
thermal sections beginning at a temperature of 1200°C
and down to room temperature. (W.L.H.)

564   NP-tr-286(p.442-73)
ALLOYS OF RHENIUM WITH REFRACTORY METALS
(Mo, Ti, Zr, Ta, Ni, Co, Cr, W, Mn). E. (Ye.) M.
Savitskii (Savitskiy) and M. A. Tylkina. 32p.

An experimental study of the systems of Re with Ti,
Mo, Ta, Cr, Ni, Co, Zr, W, and Mn was made. The
hardness, melting point, and electric resistivity of
these alloys were studied. In a number of systems with
Re, a σ-phase or an α–Mn-type phase is formed, char-
acterized by great hardness and brittleness. (W.L.H.)

565
IONIZATION X-RAY APPARATUS FOR INVESTI� ᴵNG
REFRACTORIES. S. P. Shmitt-Foglevich and V. I.
Sadkov. Byull. Nauch. Tekh. Inform. Vsesoyuz. Inst.
Nauch. Issledovatel. i Ogneupor. Prom. Proyektn. Rabot.
No. 5, 103-18(1958). (Translated from Referat. Zhur.
Met. No. 1, 1959, p.6)

A description, general view, and layout are given of
an ionization x-ray apparatus constructed for x-ray in-
vestigation of refractories. Identification of the follow-
ing structurally similar crystalline phases was carried
out: kaolin and clay, mullite and sillimanite, and zirco-
nium dioxide of cubic and monoclinic varieties. With
x-ray-diffraction patterns (X) identical for the minerals
compared, significant differences in the intensity of the
lines and the values for the interplane distances were
found. The phase composition of corundum-mullite
mixtures was determined quantitatively. Compared to
the conventional Debye diagrams the precision of the
results obtained on the X's photographed is the same,
while the time needed for the determinations (exposure
and development of X) is appreciably reduced, thus
rendering the ionization method less labor-consuming
than the Debye method. Besides, the presence of a Pt
furnace permits the photographing of X's at tempera-
tures up to 1500°C.

566
SOME OBSERVATIONS ON THE PHENOMENON OF
REVERSION IN Al–Zn ALLOY WITH 10% ZINC.
INFLUENCE OF COLD-HAMMERING ON DECOMPO-
SITION OF THE SOLID SOLUTION OBTAINED BY
REVERSION. René Graf. Compt. rend. 249, 1110-
12(1959) Sept. 28. (In French)

A systematic study was made of the behavior of Al–
10% Zn, completely aged at ordinary temperature, when
subjected to isothermal treatments done at temperatures
distributed between 50 and 200°C. The hardness curves
are presented and discussed. (T.R.H.)

567
ROLE OF STRUCTURAL DEFECTS IN THE SINTERING
OF ALUMINA AND MAGNESIA. John T. Jones, Pranab
K. Maitra, and Ivan B. Cutler (Univ. of Utah, Salt Lake
City). J. Am. Ceram. Soc. 41, 353-7(1958) Sept.

Alumina and magnesia compositions containing addi-
tions of titanium, chromium, manganese, iron, and zir-
conium oxides were sintered in atmospheres of oxygen,
nitrogen, and hydrogen. Diffusion promoted by lattice
defects was observed by measurements of bulk density.
Color, atmosphere, and x-ray diffraction indicated the
nature of the structural defects resulting in increased
rates of material transport. (auth)

568
FIXATION OF RADIOACTIVE WASTES BY FUSION
WITH SILICATE MELTS. Jiří Beránek (Komise pro
atomovou energii, [Prague]); Karel Lustig (Obalový
ústav, Prague); and Jaroslav Saidl (Ústav jaderného
výzhumu ČSAV, Prague). Jaderná energie 5, 261-5
(1959). (In Czech.)

The possibilities for fixation of radioactive wastes
are briefly summarized, and waste disposal in glass
is indicated to be the safest method. Details on the
selection of raw materials from local resources and
the different steps of technological operations are
given. In conclusion various possibilities of radioac-
tive glass storage are discussed. (auth)

569
TECHNIQUE FOR THE METALLOGRAPHIC INVESTI-

GATION OF BORON CARBIDE. G. V. Samsonov and S. S. Kiparisov. Sbornik Nauch. Trudov Moskov. Inst. Tsvetnoi Met. i Zolota, Nauch. Tekh. Obshchestva Tsvetnoi Met., No. 29, 367-71(1958). (Translated from Referat. Zhur. Met., No. 2, 1959, p.253).

A survey and analysis is presented of the existing methods of preparation and etching of microsections (M) of compact B_4C specimens. Results are described of the investigation of the feasibility of using powdered boron carbide for polishing and the anodic method for etching of the specimens of B_4C. It is established that by successive polishing with two size fractions of B_4C powder it is possible to attain a sufficiently smooth finish of the M even though at the expense of a some- what longer time (~ 2 hours), without using the expen- sive diamond powder. The M preparation method consists of the following: on the specimen an area is ground out with a carborundum wheel, the operation requiring 10 to 15 min at 1750 rpm. The area is treated with 50 to 74 μ B_4C powder applied in the form of a thick slurry in kerosene or machine oil on a cast iron disc rotating at the rate of 1000 rpm. This treat- ment requires 25 to 30 min. The second treatment with 5 to 7 μ B_4C powder also on a cast iron disc re- quires 1 to 1.5 hours. The ground surface is buffed with a cloth disc with a suspension of Al oxide in water. In order to bring out the structure of B_4C the M is treated by anodic etching in a 20% aqueous KOH-solution bath with a Cu cathode. The structure is brought out with sufficient distinctiveness after 5 to 10 sec of etching with an anode cd of 5 to 10 amp/mm² and a potential of 8 to 10 v. A method for the preparation of B_4C powder microsections is described.

570

METHODOLOGICAL PROBLEMS IN THE USE OF RADIOACTIVE TRACERS FOR THE CONTROL OF PROCESSES OF THE RECOVERY OF RARE METALS. A. A. Grizik and N. I. Marunina. Trudy Komissii Anal. Khim. Akad. Nauk S.S.S.R. 9, 333-40(1958). (Translated from Referat. Zhur. Met., No. 2, 1959, p.247).

Some methodological problems are examined that arise in the use of radioactive tracers (RT) for the control of processes of the recovery of rare metals and the advantages and shortcomings connected with the application of RT are examined. Recommendations are made for the selection of methods for the mass analysis of specimens for Ta and Nb with a view of decreasing the consumption of these materials. The design of a device for measuring the activity at different points of the ingot examined and the results of experi- ments conducted in the investigation of distribution of Sb along a Ge single crystal which was obtained by drawing from a melt are described. An extensive ap- plication of the autoradiographic method is noted, and the technology of the control of the homogeneity of alloys based on rare metals such as Bi, Sb, In, Ga, and Ti is described. It is pointed out that the method of introduction of RT is very important for obtaining correct control results. The tracer and the admixture should be in the same chemical state in the feed sub- stance. Therefore, a specific method of introduction of RT is selected for each particular case. Examples are adduced of the introduction of RT into niobium pentoxide, which is the raw material in preparation of metallic Nb.

571

THE METALLURGY OF NUCLEAR-REACTOR FUELS.

Khou. Vsesoyuz. Sbornik Met. Yader. Energ. i Deistv. Obluchen. Mater. Moscow, Metallurgizdat, 47-88(1956). (Translated from Referat. Zhur. Met. No. 1, p.200).

A survey of the modern technology of preparation and application of various types of heat-emitting elements in reactors and of individual investigations in the field of metallography and metallurgy of U, Th, Zr, and other elements is presented. An examination is made of heat- emitting elements on a U and Pu base, elements with fissionable material dispersed in a metallic matrix, ceramic compounds on graphite, BeO, SiC, and other bases, also of liquid-fuel systems. Some problems are discussed concerning the metallurgy and technology of the production of U and its alloys, as well as of diffu- sion, corrosion, and chemical equilibrium at elevated temperatures.

572

AN IODIDE METHOD OF REFINING ZIRCONIUM. A CONTRIBUTION TO THE PROBLEM OF THE RELATIONSHIP OF RATE OF DEPOSITION OF THE METAL TO THE TEMPERATURE OF AN INCAN- DESCENT ZIRCONIUM FILAMENT. V. S. Emel'yanov, P. D. Bystrov, and A. I. Evstyukhin. Vsesoyuz. Sbornik Nekotorye Voprosy Inzh. Fiz. Moskov, No. 2, 15-23(1957). (Translated from Referat. Zhur. Met., No. 9, 1958, p.95).

Taking the hypothesis that processes of diffusion are decisive in the kinetics of the process of the trans- fer of Zr to a central filament (F), it is shown that the rate of deposition of the Zr on the F is directly propor- tional to the pressure of free I near the surface of the F, and that this in turn determines the temperature of the F. Inasmuch as the vapor pressure of the I around the F cannot exceed the total pressure in the apparatus, which is governed by the wall temperature, the rate of deposition of Zr on the F ceases to increase with a further rise in F temperature after the attainment of some specific F temperature which depends upon the total pressure in the apparatus. These concepts afford an explanation of the available experimental data of various authors on the dependence of the rate of Zr deposition upon an F on the temperature of that F. It is also shown that the quantity of Q_A introduced by Döring and Molière (J. H. Döring, K. Molière, Z. für Elektrochemie, 1952, Vol 56, Nr 4, p403) in the equation $\log \alpha$ const Q_A/RT_D, where α is the rate of Zr deposition and T_{D_1} is the temperature of the F, is related to ΔH in the process of dissociation by the expression $Q_A = \Delta H/4$. If account be taken of the formation of lower Zr iodides on the surface of the F, the value of Q_A is also dependent upon the vapor pressure of the ZrI_4.

573

EKSPERIMENTAL'NAYA TEKHNIKA I METODY ISSLEDOVANIY PRI VYSOKIKH TEMPERATURAKH; TRUDY SOVESHCHANIYA. (Experimental Techniques and Methods of Investigation at High Temperatures; Transactions of the Conference on Experimental Tech- niques and Methods of Investigation at High Tempera- tures). A. M. Samarin, ed. Moscow, AN SSSR, 1959. 789p.

A collection of scientific papers divided into six parts is presented. Information on thermodynamic activity and kinetics of high-temperature processes is given along with constitution diagrams, and physical properties of liquid metals and slags. New analytical methods, pure metal production, and pyrometry are dis-

cussed, and a section of general questions is included. (TCO)

574

ZMOCHUVANNYA RIDKYMY METALAMY POVER-KHEN' TUHOPLAVKYKH SPOLUK. (Wetting the Surface of High-Melting Alloys with Liquid Metals). Valentyn Nykyforovych Eremenko and Vladymyrovych Naydych Yuryy. Kiev, Vyd-vo AN Ukrayins'koyi RSR, 1958. 59p.

Problems of wetting high-melting alloys with molten metal, a process used in the manufacture of heat-resistant materials, are discussed. Results of experimental and theoretical investigations of the wetting process are presented and general thermodynamic principles are described. The book is intended for engineers and scientific personnel working in the physical chemistry of molten metals. (W.D.M.)

575

ALLOYS OF BERYLLIUM. (to United Kingdom Atomic Energy Authority). British Patent 821,424. Oct. 7, 1959.

The preparation of Be alloys with Pu, U, or Ac is described. Powdered Be is mixed with UF_4, PuF_4, or $AcCl_3$ and heated in vacuum to reduce the fluoride, distill the BeF_2 formed, and alloy the metal with Be. (T.R.H.)

Corrosion

576   CF-59-10-69
Oak Ridge National Lab., Tenn.
IMPROVED BOLTING MATERIALS FOR INTERNAL ASSEMBLY OF HRP COMPONENTS. B. D. Draper. Oct. 1, 1959. 10p. OTS.

An investigation was made to improve materials and practices used in the internal bolting of HRP components. Wire type stainless steel thread inserts were found to be corrosion resistant and non-galling, although somewhat difficult to install and remove. These operations are especially troublesome if done remotely. Two alloys were found to be corrosion-resistant, nongalling and of high strength: CD4MCu and Uniloy 19-9 DL. Other promising alloys, which however require additional testing, are AM-355, Timken 16-25-6 and Timken 16-15-6. (auth)

577   HW-53636
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
INHIBITION OF HNO_3 — HF CORROSION OF TYPE 304-L STAINLESS STEEL WITH $Al(NO_3)_3 \cdot 9H_2O$. W. L. Walker. Nov. 18, 1957. 3p. OTS.

To prevent corrosion of equipment by nitric acid — hydrofluoric acid mixture, aluminum nitrate nonohydrate is added to tie up the fluoride, either as aluminum fluoride or a tight complex. It was found that a solution of nitric acid, hydrofluoric acid, and aluminum nitrate nonohydrate in which the hydrofluoric acid — aluminum nitrate nonohydrate molar ratio is 3, did not show serious corrosive attack on the 300-series stainless steel. (J.E.D.)

578   KR-2
Norway. Institutt for Atomenergi, Kjeller.
NOTES ON MECHANISM OF THE AQUEOUS CORROSION OF ALUMINUM AT ELEVATED TEMPERATURES. Ketil Videm. Sept. 1959. 24p.

The formation of oxide films (protective and non-

protective) on superpure aluminum under polarization at 200°C was studied and the breakdown of protective films was followed. Film formation on aluminum alloys was briefly investigated. The results are combined with the general theories for oxidation, and proposals for modifications in order to bring the oxidation theories nearer to reality for aqueous corrosion are presented. It is suggested that there is no single rate-determining step but a series of events that finally determine the over-all corrosion rate. In corrosion resistant Al alloys there is a migration of Al^{3+} ions through a semiconducting barrier layer. The thickness and thus also the flow of ions through this layer is controlled by a breakdown mechanism of the barrier layer. The rate of the destruction is again dependent upon the thickness and tightness of layers outside the barrier films. The beneficial effect of alloying elements is assumed to be partly electrochemical. Suggestions are made for the mechanism of the grain boundary attack. Also, modifications of the oxidation theory are required in order to make it fit with the experimental observations. (auth)

579   MSAR-59-112
MSA Research Corp., Callery, Penna.
CORROSION OF AUSTENITIC PIPING BY A SEA WATER-AIR ATMOSPHERE. Technical Report 66. M. J. McGoff. Oct. 16, 1959. 12p. Contract NObs-77023.

Stressed type 304 stainless steel pipe specimens were exposed to a high humidity sea water-air environment for a 1000-hr period to investigate the occurrence of chloride stress corrosion. Constant temperature specimens were held at 550, 400, 200, and 125°F and cyclic specimens were varied from 550 to 125°F in a compartment where the ambient temperature was 125°F. Chloride stress corrosion occurred with specimens whose temperature was 125°F whereas higher temperature specimens and those which were thermally cycled from 125 to 550 to 125°F every 24 hr did not show corrosion. (auth)

580   USBM-U-378
Bureau of Mines, Albany, Oreg.
THE EFFECT OF SILICON ON THE HOT WATER AND STEAM CORROSION RATES OF ZIRCALOY 2. M. D. Carver and H. Kato. Dec. 10, 1957. Changed from OFFICIAL USE ONLY Oct. 20, 1959. 11p. OTS.

The effects of silicon in the range of 40 to 372 ppm on the resistance of Zircaloy-2 to the corrosive action of pressurized hot water and steam were investigated. The data were inconclusive that the corrosion rate in hot water varied with silicon content. But the data showed the corrosion rate in pressurized steam to increase slightly with increasing silicon content in the range of 149 to 372 ppm silicon. (auth)

581   WAPD-CP-715(Del.)
Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.
CORROSION OF D LOOP. H. K. Lembersky and P. Cohen. [Oct. 11, 1955]. Decl. with deletions Nov. 20, 1957. 15p. OTS.

The effect of aging on the rate of corrosion in D loop, a large type 347 stainless steel circulating water system, was determined. The study of the possible effect of high water purity on the corrosion rate was a secondary objective of the investigation. The loop was operated for approximately 700 hrs with degassed system water at 1700 psi pressure, 490°F temperature, and a

flow of 3200 to 4000 gpm. Corrosion rate was determined by hydrogen evolution. (W.D.M.)

582   WAPD-MDM-8(Del.)

Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.

HEAT TRANSFER EFFECTS ON THE CORROSION OF ZIRCONIUM AND SOME ALLOYS. Louis A. Waldman and Paul Cohen. May 13, 1954. Decl. with deletions Mar. 14, 1957. 32p. Contract AT-11-1-GEN-14. OTS.

A study was made of the quantitative relationship between heat transfer and the corrosion of zirconium alloys through an investigation of accelerated corrosion rates as a function of thermal gradients in an oxide film. This treatment was based on available isothermal corrosion data and on heat transfer data obtained by direct measurements on the corroded metal. An application of this analysis to the PWR reference design indicates that heat transfer corrosion does not pose a problem for the core lifetimes under consideration. However, the analysis indicates that future reactors designed for higher fluxes and surface temperatures may be limited in their operation, especially for the case of heavy fouling on the corroded metal. (auth)

583   CEA-tr-A-549

OXYDATION INTERGRANULAIRE DES ACIERS AU CrNiW. (Intergranular Oxidation of Steels With Cr, Ni, and W). P. Csokan. Translated into French from Metalloberfläche 12, 230-2(1958). 9p.

The fabrication of pieces for mechanical construction subject to high dynamic stresses out of Cr−Ni−W steel gives good results. These pieces have excellent shock resistance, but are subject to decarburization and cracking. This process was studied experimentally, and found to be due to formation of a heterogeneous intercrystalline phase and the considerable reduction in fatigue resistance. (T.R.H.)

584

HIGH-TEMPERATURE REACTION RATES OF SEVERAL METALS WITH HYDROGEN CHLORIDE AND WATER VAPOR. Milton Farber (Rocket Power, Inc., Pasadena, Calif.). J. Electrochem. Soc. 106, 751-4(1959) Sept.

An experimental study was made of the high-temperature reaction rates of various metal filaments with HCl and H_2O vapors and mixtures of the two. Measurements were made by an electrical method in which the change in resistance of the metal filament was related to the loss in pure metal due to the vapor-metal reaction. Measurable reaction rates were determined for both nickel and iron in a temperature range from 1000 to 1600°K. Specific reaction rate constants and apparent activation energies are presented. The reaction rates of tungsten with H_2O vapor were measured in a temperature range from 1600 to 2000°K. The reaction rates of chromium, Inconel, stainless steel 18-8, and tungsten did not proceed at a measurable rate in either pure HCl or in mixtures of HCl and H_2O. Nickel, copper, Inconel, and stainless steel 18-8 did not react appreciably with water vapor at temperatures approaching the melting points. The reaction rates for iron in pure HCl varied from 0.03 to 0.04% area loss per second over the temperature range investigated with an apparent activation energy of 10.5 kcal/mole. The reaction rates of iron in mixtures of HCl and H_2O varied from 0.08 to 0.17% area loss per second in the same temperature range with an apparent activation energy of 8.5 kcal/mole. Reaction rates of nickel in pure HCl varied from 0.005 to

0.03% area loss per second in the temperature range of 1000 to 1600°K with an apparent activation energy of 13 kcal/mole. The reaction rates of nickel in the HCl and H_2O mixtures varied from 0.004 to 0.03% area loss per second in the same temperature range with an apparent activation energy of 22 kcal/mole below 1300°K and 13 kcal/mole above this temperature. Reaction rates of iron in H_2O vapor varied from 0.002 to 0.05% area loss per second from 1120 to 1415°K with an activation energy of 28 kcal/mole. Reaction rates of tungsten in H_2O vapor varied from 0.02 to 0.03% area loss per second from 1700 to 2000°K with an activation energy of 14.5 kcal/mole. (auth)

585

FRETTING CORROSION OF METALS. R. T. Allsop. Metallurgia 60, 39-43(1959) Aug.

Damage resulting from fretting corrosion is observed in a variety of engineering components including bearings, switchgear, and bolted or riveted joints. The nature and occurrence of fretting corrosion are examined and various theories which have been proposed to explain the phenomenon are discussed. The effect of varying such factors as humidity, duration, load, etc., on the amount of damage occurring during fretting is considered. Methods of eliminating or reducing fretting damage are suggested. (auth)

586

ALUMINUM ALLOYS FOR WATER-COOLED REACTORS. J. B. Cotton (Imperial Chemical Industries, Ltd., Widnes, Lancs, Eng.). Nuclear Power 4, No. 42, 100-2(1959) Oct.

Alloys of aluminum which withstand temperatures at 300°C for long periods of time are reported. These alloys are basically aluminum−iron−nickel with additions of silicon, titanium, beryllium, or zirconium. (C.J.G.)

587

MASS-TRANSPORT AND CORROSION OF IRON-BASED ALLOYS IN LIQUID METALS. G. W. Horsley (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Reactor Technol. 1, 84-91(1959) Aug.

The application of mass-transport equations to the corrosion of metals by liquid metals is discussed. Calculated corrosion rates are compared with experimentally determined rates. It is concluded that diffusion controlled solution attack, although significant, may not under conditions of interest to reactor engineers be as serious as either inter-granular attack or chemically assisted mass-transport. The mechanism of inter-granular attack, the thermodynamics of an example of chemically assisted mass-transport, the role of oxygen in sodium-stainless steel circuits, and methods of reducing mass-transport of iron are discussed. (auth)

588

NEW CORROSION-RESISTANT HIGH-CHROMIUM ALLOYS FOR CASTING. K. I. Vashchenko and L. I. Rostovtsev. Sbornik Statei Vsesoyuz. Nauch. Issledovatel. i Konstrukt. Inst. Khim. Mashinostroeniya 23, 14-37(1957). (Translated from Referat. Zhur. Met. No. 1, 1959, p.172).

Corrosion resistance of specimens and components were investigated in 67% HNO_3, in boiling 25 and 5% HNO_3, in 93% H_2SO_4, and in 50% CH_3COOH. Mechanical properties (σ_b, δ, and a_k), microstructure and fluidity of cast Cr steels were also investigated. This included steels containing additions of Cu (up to 1.5%) and Ti (up

to 0.32%). It was established that an increase in Cr content beyond 23% (at 0.35% C) produces a slight increase in the corrosion resistance of the metal in an HNO₃ solution. Addition of Cu and Ti did not have any effect. Steels are recommended for operations involving contact with HNO₃. The mechanical properties of the alloys (without heat treatment) are σ_b 40—45 kg/mm²; δ 1.0—2.0%; a_k 0.25—0.8 kgm/cm², and H_B 179 to 197.

Fabrication

589   FMPC-477
National Lead Co. of Ohio, Cincinnati.
STANDARD OPERATING PROCEDURE FOR ROLLING 2.75% ENRICHED METAL AT SIMONDS SAW AND STEEL COMPANY. Production Order No. 296. (Section 1.4.3.12). John F. Schlitz. Oct. 20, 1954. Decl. Aug. 14, 1959. 7p. Contract AT(30-1)-1156. OTS.

590   NP-7925
Mallory-Sharon Metals Corp., Niles, Ohio.
THE ELECTRON BEAM MELTING OF BERYLLIUM, BORON, BORON CARBIDE, TANTALUM CARBIDE, TITANIUM CARBIDE, TUNGSTEN AND ZIRCONIUM DI-BORIDE. Quarterly Progress Report No. 4. S. R. Seagle and Stanley Abkowitz. May 1959. 17p. Contract AF33(616)-5603.
Results indicate the following: buttons of zirconium di-boride, tantalum carbide, and titanium carbide cannot be obtained by electron beam melting; small ingots or buttons of boron can be obtained by electron beam melting, but the boron is still very brittle; and the chromium content of beryllium is reduced by electron beam melting. (auth)

591   NP-7926
Mallory-Sharon Metals Corp., Niles, Ohio.
THE ELECTRON BEAM MELTING OF BERYLLIUM, BORON, BORON CARBIDE, TANTALUM CARBIDE, TITANIUM CARBIDE, TUNGSTEN, AND ZIRCONIUM DI-BORIDE. Quarterly Progress Report No. 3. S. R. Seagle and Stanley Abkowitz. Feb. 1959. 10p. Contract AF33(616)-5603.
Electron beam melting and evaluations of small ingots of boron, boron carbide, titanium carbide, tungsten, and zirconium diboride are reported. The procedure for electron melting of pure beryllium ingots is outlined. (J.E.D.)

592   NP-7927
Mallory-Sharon Metals Corp., Niles, Ohio.
THE ELECTRON BEAM MELTING OF BERYLLIUM, BORON, BORON CARBIDE, TANTALUM CARBIDE, TITANIUM CARBIDE, TUNGSTEN, AND ZIRCONIUM DI-BORIDE. Quarterly Progress Report No. 2. Charles B. Dittmar and Stanley Abkowitz. Nov. 1958. 8p. Contract AF33(616)-5603.
Preliminary results are reported from the electron beam melting study. TiC and ZrB₂ could not be melted satisfactorily. (J.E.D.)

593   NP-7929
Mallory-Sharon Metals Corp., Niles, Ohio.
THE ELECTRON BEAM MELTING OF BERYLLIUM, BORON, BORON CARBIDE, TANTALUM CARBIDE, TITANIUM CARBIDE, TUNGSTEN, AND ZIRCONIUM DI-BORIDE. Quarterly Progress Report No. 5. S. R. Seagle and Stanley Abkowitz. Aug. 1959. 29p. Contract AF33(616)-5603.
Electron beam melting and evaluation of small ingots

of boron, boron carbide, titanium carbide, tungsten, zirconium diboride, and beryllium are presented. The facility for beam melting beryllium has a special ventilation system and is operated under rigid safety requirements to assure control of beryllium toxicity hazards. The method of electron beam melting appears to effect the ductility of extruded and annealed beryllium. Silicon additions to boron reduce the grain size of as-cast boron. The current status of the work is outlined. (J.E.D.)

594   SCNC-290
Sylvania-Corning Nuclear Corp., Bayside, N. Y.
THORIA-URANIA PELLET PREPARATION. H. Shapiro and R. M. Powers. Aug. 1959. 34p. Contract AT-30-GEN-366. OTS.
The development of a preparation procedure for ThO₂—UO₂ compositions with more than 90% of theoretical density, at temperatures below 1500°C is reported. The effect of small additions of Y₂O₃ on the sinterability and certain other properties of these compositions was investigated. The physical properties which were studied were thermal conductivity, thermal expansion, modulus of elasticity, and resistance to steam corrosion. (W.L.H.)

595   SCTM-426-58(16)
Sandia Corp., Albuquerque, N. Mex.
A DETERMINATION OF DESIGN STRENGTHS FOR 6061-T6 ALUMINUM WELDMENTS. D. W. Grobecker. Jan. 7, 1959. 37p. Contract AT(29-1)-789. OTS.
A determination of design allowable strengths for Type 6061-T6 aluminum weldments was made by destructive evaluation of a simulated-production test assembly. Test weldments involving plate and sheet were designed according to the requirements of Class IA and IIB, SCS-16, and in the as-welded and heat-treated conditions. Eighty test weldments were purchased from ten fabricators and were sectioned into ten different types of test specimens. A total of 1760 individual samples were destructively tested to determine average fracture strengths. The program showed that average test strengths approximated 70 percent of the commonly accepted design values, that test strengths were highly dependent on the source of supply or technique of the operator, and that lack of penetration was the defect causing the most serious degradation of weldment properties. In addition, the program illustrated some of the limitations of nondestructive inspection methods and showed that frequent destructive evaluation of production weldments may be the most practical way to ascertain that the required strength levels are achieved and maintained. (auth)

596   WAPD-116(Del.)
Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.
DEVELOPMENT OF ROLL BONDED SUBASSEMBLIES. F. G. Stengel. Dec. 2, 1954. Decl. with deletions Feb. 20, 1957. 24p. Contract AT-11-1-GEN-14. OTS.
The roll bonding of flat plate subassemblies of many varied designs appears to be a practical and progressive step in the development of advanced plate-type nuclear reactor components. Cross-sectional configurations which hitherto could not be considered can be fabricated with improvements in spacing and cladding uniformity as well as time and material savings. (auth)

597   WAPD-MDM-6(Del.)
Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.

THE EXTRUSION OF A CONTROL ROD CRUCIFORM SHAPE FROM ZIRCALOY-1. J. Halapatz. May 6, 1954. Decl. with deletions Apr. 30, 1957. 8p. Contract AT-11-1-GEN-14. OTS.

Commercial extrusions of a control rod cruciform shape using Zircaloy-1 to simulate hafnium were unsuccessfully extruded from SAE 1020 steel the mild steel billet was extruded at 2200°F with a press loading of 2120 tons which was also required for the Zircaloy-1 extrusion at 1800°F. (W.D.M.)

598   WAPD-PWR-(RD2)-378

Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.

CSM-2—BOTTOM SUPPORT WELDING FEASIBILITY TEST. TEST REPORT. R. A. Cooper and A. V. Smocer. [1958]. Includes appendix I: PROCEDURE FOR WELDING PWR CORE II BOTTOM SUPPORT WELDING MOCK-UP. E. E. Callen. (WAPD-NCE-8859). 36p. OTS.

To assess the effects of welding, a test was conducted in which a partial section of a full sized PWR bottom support was fabricated under prototype conditions. Results are discussed and data on contraction and deflection are shown in diagrams. (J.R.D.)

599   WAPD-RM-181(Del.)

Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.

PRODUCTION OF PLATE FROM CRYSTAL BAR HAFNIUM. W. J. Hurford and R. J. McClintick. May 21, 1953. Decl. with deletions May 3, 1957. 11p. Contract AT-11-1-GEN-14. OTS.

The manufacturing procedure for conversion of crystal bar hafnium to hot rolled plates for reactor control rods is described. The report includes detailed arc melting, forging and rolling procedures, contamination during processing, ingot and plate hardnesses, and processing times and yields based on processing 1300 pounds of hafnium. (auth)

600

THE TECHNOLOGY OF ZIRCONIUM AND ITS ALLOYS. PART 1. PRODUCTION AND COST; EXTRACTION; MELTING; FABRICATION; SURFACE TREATMENT; SCRAP RECOVERY; JOINING. D. R. Harries (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Chem. & Process Eng. 40, 313-16, 319(1959) Sept.

Production and cost of reactor-grade zirconium are discussed. Production by the Kroll and Van Arkel processes is outlined. Contamination and galling problems encountered in fabrication are discussed. Problems in welding zirconium and Zircaloy-2 and -3 alloys are described. (C.J.G.)

601

THE PRESSING OF REFRACTORIES CONTAINING GRAPHITE AND CARBORUNDUM IN THERMOPLASTIC STATE. I. S. Kaynarskii, I. G. Orlova, and Ye. V. Merkulova. Ogneupory 24, No. 4, 173-80(1959).

Results of pressing thermoplastic graphite- and carborundum-containing masses are described. Experiments showed that it is possible to obtain first-rate products by pressing graphite-clay-containing masses in thermoplastic state, especially when using ground graphite the structure was improved. Properties of the pressed products are given. (TCO)

602

ALUMINUM ARC CUTTING UNDER RARE-GAS PROTECTION. L. Gajdos (Technische Universität, Budapest). Periodica Polytech. (Eng.) 3, 169-87(1959). (In German)

Arc cutting of aluminum in a rare gas atmosphere with tungsten electrodes is a rapid method for the cutting of pure and alloyed aluminum. In the correct selection of cutting parameters (current intensity, gas volume, gas composition, cutting velocity, arc length, and electrode diameter) a smooth-walled, sharp angle cut, which needs only slight finishing, is obtained. Basically the method depends on the melting of the metal which is expelled from the cut by the strong gas current. An investigation was made on 4, 5, and 6 mm thick plates of pure and alloyed aluminum to determine the effects of the parameters and the general characteristics of the operation. The results are discussed. (tr-auth)

603

URANIUM—ALUMINUM ALLOYS WITH LOW ALUMINUM CONTENT. Kaben, Englander, and Lemann. Vsesoyuz. Sbornik Met. Yader. Energ. i Deistv. Obluchen. Mater. Moscow, Metallurgizdat, 176-220 (1956). (Translated from Referat. Zhur. Met. No. 1, 1957, p.200).

In order to establish procedures for heat treatment of U—Al alloys a solubility curve for Al in γU was plotted. The solubility of Al in alloys quench-hardened at 745 to 1000°C was determined by the appearance of the UAl$_2$ phase which separated from the solid solution. In order to find an isotropic structure that would be resistant to thermal fatigue the authors investigated alloys of a near-eutectoid composition with 0.15, 0.2, 0.4, and 0.5% Al, prepared by smelting in graphite crucibles lined with Al$_2$O$_3$. To avoid contamination the heat treatment was carried out in an atmosphere or pure Ar. The cast alloys have a two-phase structure consisting of coarse, irregular grains of U and UAl$_2$ intermetalloids which separate in various forms depending on the Al content. It was found that additions of Al lower the temperature of β–γ transformation by ~15°C during heating and by 20°C during cooling. Investigation of the microstructure, mechanical properties, and thermal fatigue under cyclic heating was carried out on cast alloys and those subjected to various heat treatments. It was established that introducing Al in the form of a UAl$_2$ intermetalloid improves the resistance of U to thermal fatigue. Cast alloys with 0.15 to 0.5% Al exhibit better properties than cast or machined U. Heat-treated alloys have a much greater resistance to thermal fatigue than cast alloys. A procedure established for heat treatment of these alloys includes heating to 1040°C for 300 hours to dissolve the UAl$_2$, quenching in oil, and tempering at 580°C for two hours.

604

ELECTRON-BEAM WELDING. EXPERIMENTAL RESULTS ACHIEVED BY THE INITIAL DEVELOPMENT INVESTIGATION AND THEIR APPLICATIONS ARE DESCRIBED. G. Burton, Jr. and L. Frankhouser (Westinghouse Electric Corp., Pittsburgh). Welding J. (N. Y.) 38, 401s-9s(1959) Oct.

A high-voltage electron-beam welding machine with a maximum beam power of 1 kw was used to make butt-joint weld penetration up to 0.250 in. in Zircaloy-2. Chemical analyses, metallography, corrosion tests, and mechanical-property evaluations have revealed satisfactory properties in the Zircaloy-2 welded by this process. The high-voltage (50 to 100 kv) electron-beam equipment has distinct advantages for extreme concentration of welding heat not realized with other processes

nor with low voltage (5 to 50 kv) electron beam equipment. As a result, potential production applications are foreseen in welding fuel assemblies for the nuclear reactor industry. (auth)

605

WELDING OF BERYLLIUM. METHODS STUDIED AND THE RESULTS OBTAINED DURING THE INITIAL INVESTIGATION OF BERYLLIUM JOINING BY VARIOUS METHODS ARE PRESENTED. E. L. Brundige, R. S. Kirby, G. S. Hanks, and J. M. Taub (Los Alamos Scientific Lab., N. Mex.). Welding J. (N. Y.) 38, 410s–13s(1959) Oct.

Satisfactory fusion welding of beryllium without the use of filler metal was found to be impractical, due to cracking either in or adjacent to the weld zone. Acceptable welds were made using braze-welding techniques. Two processes were developed which produce consistent, reproducible joints. One process involves the use of the inert-gas-shielded tungsten-arc welding process with pure silver as the filler metal. In the second process, the inert-gas-shielded metal-arc welding technique was employed using an aluminum–12 w/o silicon alloy as the consumable electrode. The consumable-electrode technique produced consistently sound welds if the width-to-depth ratio of the groove design provided for adequate penetration and shear strength. (auth)

606

DESHEATHING OF URANIUM FUEL RODS. (to Atomic Energy of Canada, Ltd.). British Patent 820,670. Sept. 23, 1959.

The decladding of Zr-clad U rods by exposing the U and treating with steam at 340 to 380°C is described. (T.R.H.)

Properties and Structure

607   AECD-4289

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

DEVELOPMENT AND PROPERTIES OF URANIUM MONOCARBIDE CERMETS. Final Report. Sept. 17, 1956. Decl. Aug. 17, 1959. 66p. Project No. B 078. For Westinghouse Electric Corp. Atomic Power Div. Contract AT-11-Gen-14, Subcontract No. 73-(14-412). OTS.

Uranium monocarbide—Zircaloy-2 alloy cermets were developed and tested for chemical and physical properties. It was demonstrated that pure uranium monocarbide can be prepared by vacuum arc melting techniques. Following melting, the comminution, hot pressing, and corrosion behavior of dense monocarbide has been studied. The preparation of uranium mono-carbide—Zircaloy-2 cermet bodies was investigated by means of hot pressing, cold pressing and sintering, warm pressing, extrusion, and hot rolling. The corrosion resistance of the cermets was related to such variables as composition, preparation technique, and powder size. Thirty per cent uranium monocarbide, 70% Zircaloy-2 cermets withstood corrosion tests in 680°F water. Cermets having above 30 wt. % uranium monocarbide were not corrosion resistant. (auth)

608   AECU-4374

Illinois. Univ., Urbana.

MEASUREMENT OF THE EQUILIBRIUM CONCENTRA-TION OF LATTICE VACANCIES IN ALUMINUM. Tech-

nical Report No. 17. R. O. Simmons and R. W. Balluffi. July 1959. 35p. Contract AT(11-1)-182. OTS.

Measurements of change in length and change in lattice parameter were made at identical temperatures on 99.995% aluminum in the temperature range 229 to 656°C. Length changes, ΔL, were measured on an unconstrained horizontal bar sample using a rigid pair of filar micrometer microscopes. X-ray lattice parameter changes, Δa, were observed using a high-angle, back-reflection, rotating-single-crystal technique. The measurements are compared to earlier work. The relative expansion $\Delta L/L$ and $\Delta a/a$ were equal within about $1:10^5$ from 229 to 415°C. At higher temperatures additional atomic sites were found to be generated: the difference between the two expansions could be represented by $3(\Delta L/L - \Delta a/a) = \exp(2.4)\exp(-0.76\mathrm{ev}/kT)$. At the melting point (660°C) the equilibrium concentration of additional sites is $3(\Delta L/L - \Delta a/a) = 9.4 \times 10^{-4}$. This result is independent of the detailed nature of the defects, for example, the lattice relaxation or degree of association. The nature of the defects is considered and it is concluded that they are predominantly lattice vacancies; it is estimated that the divacancy contribution at the melting point may well be less than about 15%, corresponding to a divacancy binding energy ≤ 0.25 ev. The observed formation energy agrees with the values obtained by quenching techniques and by interpretation of the high temperature electrical resistivity of identical material by Simmons and Balluffi. The present work is the first direct measurement of formation entropy; the value is near that expected from theoretical considerations. The contribution of the thermally generated defects to other physical properties at high temperatures is considered briefly. (auth)

609   AECU-4375

Illinois Univ., Urbana.

MEASUREMENTS OF THE HIGH TEMPERATURE ELECTRICAL RESISTANCE OF ALUMINUM: THE RE-SISTIVITY OF LATTICE VACANCIES. Technical Report No. 18. R. O. Simmons and R. W. Balluffi. July 1959. 28p. Contract AT(11-1)-182. OTS.

The electrical resistance of a 99.995% aluminum wire was measured at temperatures from 14 to 655°C. Values of temperature coefficient of resistance and of resistivity are derived; they differ somewhat from earlier work. The resistivity values show a progressive increase above the expected values at high temperatures; this is ascribed to scattering by thermally-generated point defects of the type which add atomic sites (vacancy-type defects), whose equilibrium concentrations have been measured directly in identical material at identical temperatures. Three different semiempirical methods were used to estimate the expected values of the ideal lattice resistivity in the absence of defects; they gave similar results. The limitations of extrapolation methods are discussed. The resistivity increment ascribed to the vacancy-type defects was then obtained by difference and can be represented by $\dot{\Delta}\rho = (4.4 \times 10^{-3}\ \mathrm{ohm\text{-}cm})\exp(-0.77\mathrm{ev}/kT)$. The observed formation energy is in close agreement with that obtained by direct concentration measurements and with that obtained in various quenching investigations. This increment is nearly twice the value expected from extrapolation of recent quenching work from the interval 260 to 320°C. This relatively small discrepancy can be ascribed to three factors, whose relative importance cannot be precisely evaluated at present. They are failure of quenching techniques to retain all of the equilibrium defect con-

centrations, the presence of appreciable divacancy concentrations at the highest temperatures, and a contribution to the high temperature resistivity arising from lattice anharmonicity. The increment of about 0.30 μohm-cm at the melting point (660°C) corresponds to a resistivity 3 μohm-cm/atom % monovacancies in agreement with a crude estimate based upon known effects of solute atoms of different valence. (auth)

610   AECU-4399

Illinois. Univ., Urbana.

TECHNICAL PROGRESS REPORT ON DIFFUSIONLESS PHASE CHANGES IN NON-FERROUS METALS AND ALLOYS [FOR] PERIOD JULY 16, 1955 — MARCH 31, 1956. T. A. Reed, D. S. Lieberman, and H. Birnbaum. Mar. 31, 1956. 6p. Contract AT(11-1)-67. (MEDUI-2-AEC). OTS.

Study of lattice imperfections generation by diffusionless transformation is described, and discussions of the effects of these imperfections on the properties of the transformed product are presented. Single crystals of gold cadmium alloy grown from high purity gold and cadmium were used. Stress applied after transformation produces a deformation of the specimen in addition to purely elastic strain. The properties of twin boundaries are a function of time after transformation. Measurements of diffraction line positions were made on powdered samples of the 47.5% Cd alloy (orthorhombic). The magnitude and direction of shift varied from one diffraction line to another. Further data are required to determine if the observed changes can be expressed in terms of changes in individual parameters a, b, and c of the orthorhombic structure. (J.R.D.)

611   AECU-4423

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

THE MECHANICAL PROPERTIES OF YTTRIUM, SCANDIUM AND THE RARE EARTH METALS. C. R. Simmons. Nov. 3, 1959. 55p. OTS.

Presented at American Society for Metals-Atomic Energy Commission Symposium on the Rare Earths and Related Metals, Chicago, Illinois.

A survey of the known mechanical properties of lanthanum, scandium, and the rare earths was made. The fairly comprehensive mechanical data obtained on yttrium metal are presented in detail. Scandium, the rare earths, and yttrium are discussed separately in terms of their hardness, tensile properties, and related elastic constants. (J.E.D.)

612   AERE-M-488

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

LOW MELTING POINT ALLOYS OF CERIUM WITH IRON, COBALT AND PLUTONIUM. J. K. Critchley. July 1959. 19p. BIS.

The cerium-rich portions of the Ce—Fe, Ce—Co, Ce—Fe—Co, and Ce—Co—Pu systems have been investigated by thermal analysis. Low melting alloys of potential use as fast reactor fuels occur in the Ce—Co—Pu system, and their solidification behavior has been investigated. (auth)

613   AFOSR-TN-59-774

Birmingham. Univ., England.

RESEARCH ON STRAIN-AGEING, HARDENING AND SOFTENING OF METALS BY FATIGUE. Technical Summary Report [for] September 1957 — February 1959. 125p. Contract AF61(514)-1182. (AD-219717).

Previous work relating to the fatigue of aluminum-magnesium alloys was extensively reviewed. Room temperature fatigue experiments were conducted to find the condition under which true fatigue limits occur in aluminum-magnesium alloys. In the solution-treated condition, these materials do not have fatigue limits, but in the as-extruded they do. Metallographic observations show that increasing magnesium content reduces the width of slip marks (striations) and surface cracking which occur during fatigue. Cracks were observed in aluminum — 1% magnesium, and aluminum — 3% magnesium in as-extruded specimens remaining unfailed below the fatigue limit. Tensile experiments at −196°C subsequent to fatiguing at −196°C, with intermediate resting at temperatures in the range −80 to +120°C in aluminum and aluminum-magnesium alloys, showed hardening and softening effects which are probably due to interactions of vacancies and solute atoms with dislocations. Preliminary experiments are reported showing the effect of temperature on fatigue life for a given stress in aluminum — 3% magnesium. These indicate that there is an increase in fatigue life corresponding to the hardening effects in the fatigue-tensile experiments. A technique is outlined for growing large seeded zinc crystals of any desired orientation, and a method of acid machining gage lengths in these crystals is described. Zinc crystals of five different orientations (X, Chi, between 30° and 60°) were fatigued to fracture at room temperature in push-pull tests at a frequency of 100 c/s. S-N curves were found for each orientation, and when the curves are re-plotted in terms of resolved shear stress they superimpose, indicating that the fatigue life of a crystal is determined by the shear component of the applied stress. A few crystals were also fatigued at 50 c/s, and it is shown that failure is dependent on time of testing rather than on the number of cycles. Fracture of zinc crystals by fatigue usually takes place by cleavage across the basal plane, and this initiates in a direction parallel to the active slip direction. During fatigue, specimens harden during approximately the first 3×10^4 cycles, and the flow stresses produced are one hundred times that of a virgin crystal A logarithmic law of recovery has been deduced for fatigue-hardened crystals rested at room temperature. A method has been developed for measuring hysteresis loops during fatigue, and it has been found that the amount of plastic strain per cycle decreases with increasing number of reversals for the first 10% of life and then remains constant for the remainder. (auth)

614   ANL-6046

Argonne National Lab., Lemont, Ill.

OXIDATION OF ZIRCONIUM AND ZIRCONIUM ALLOYS H. A. Porte, J. G. Schnizlein, R. C. Vogel, and D. F. Fischer. Sept. 1959. 42p. Contract W-31-109-eng-38. OTS.

Zirconium oxidation was investigated in the temperature range 400 to 900°C at oxygen pressures of 50, 200, and 800 mm. The reaction rate of massive (parallelepiped) samples was best expressed by the cubic rate law. At an oxygen pressure of 200 mm the activation energy was calculated to be 42.7 kcal per mole, and the cubic rate constant in (μg per sq cm) per minute can be expressed as $k = (5.94 \times 10^{16})e^{-42,700/RT}$. The oxidation rate was found to be relatively insensitive to various types of surface preparations in the temperature range 400 to 700°C. No dependence of reaction rate on oxygen pressure was observed. The cubic rate law also was obeyed by foil specimens at 700°C; however, the rate

constants were slightly larger than values obtained from
parallelepiped samples. The oxidations of zirconium
binary alloys containing nominally one, two, and four
atom % additives of aluminum, beryllium, carbon, chro-
mium, cobalt, copper, hafnium, iron, lead, molybdenum,
nickel, niobium, platinum, silicon, tantalum, tin, tita-
nium, tungsten, uranium, and vanadium were studied at
700°C and 200 mm oxygen. The alloys were grouped ac-
cording to four types of oxidation behavior. Two groups
consisted of alloys which oxidized according to the cubic
rate law (Group I) or parabolic rate law (Group II) and
did not exhibit breakaway phenomena. The other groups
were alloys which initially oxidized according to the
cubic rate law (Group III) or parabolic rate law (Group
IV) but later exhibited breakaway oxidation phenomena.
For alloys of those additives which are soluble in zir-
conium the initial oxidation rates are explained accord-
ing to a valency effect in terms of the Wagner-Hauffe
theory of alloy oxidation. For additives insoluble in
zirconium, no single theory is felt to be adequate. The
breakaway phenomena observed for many of the alloys
is explained in terms of a 15% deviation of the additive
ionic radius from the ionic radius of Zr^{4+}. Some x-ray
and electron diffraction studies, which indicate that for
zirconium and some of its alloys the breakaway occurs
as a result of a polymorphic transformation in the zir-
conium dioxide film, were made. (auth)

615   BMI-731(Del.)
Battelle Memorial Inst., Columbus, Ohio.
PROGRESS REPORT FOR THE MONTH OF FEBRUARY
1952. H. W. Russell, H. R. Nelson, and R. W. Dayton.
Mar. 1, 1952. Decl. with deletions Apr. 18, 1957. 43p.
Contract W-7405-eng-92. OTS.

In the development of ceramic fuel elements continu-
ing research has shown that resistance of sintered
beryllia to thermal fracture increases with increasing
density. Post-irradiation measurements of thermal and
electrical conductivity on graphite fuel elements con-
taining nodularly placed U reveal irradiation damage to
decrease with increased nodule size. The compound
$Nb_2O_5 \cdot 2MgO$ was formed by pressing and sintering
mixtures of the oxide powders, and moduli of rupture
values were determined over the temperature range
25 to 1200°C. Progress is reported in the development
of zirconia crucibles for melting Zr and in the develop-
ment of high-density graphite. Investigation of the ef-
fect of thermally cycling U during creep-testing has
shown that the total deformation and the creep rate in-
crease as the span of the thermal cycle increases. It
was also determined that when cycling over a fixed
temperature span, deformation increases markedly with
temperature in the range 400 to 500°C. Collateral
studies of grain refinement by alloying show that Cr is
a more effective grain-refining addition to U alloys than
either Ti or V. Data from plate-bending fatigue tests
on unnotched and on notched Th sheet specimens indi-
cate that Th is only moderately notch sensitive. Pre-
liminary roll-cladding studies of Th indicate that Th
can be successfully dip-clad with Sn. In the develop-
ment of liquid coolants and fuels, studies have been
made on the preparation of pure anhydrous sulfides.
Thermodynamic studies of the stability of Na hydrosul-
fide indicate the decomposition pressure of H_2S is not
excessive. In studies of corrosion by alkali hydroxides,
screening tests on various alloys in NaOH at 1500°F
showed that an alloy of Ni with 0.27% Zr was quite cor-
rosive resistant. Corrosion data are included for vari-

ous material combinations of interest for use in poten-
tial water-lubricated bearings. (W.L.H.)

616   CEA-920
France. Commissariat à l'Energie Atomique, Paris.
ALLIAGES URANIUM—MOLYBDENE DE 0.5 a 3% EN
POIDS DE MOLYBDENE. CARACTÉRISTIQUES
GENERALES CINETIQUES DE TRANSFORMATION.
(Uranium—Molybdenum Alloys Containing 0.5 to 3 Per
Cent by Weight of Molybdenum.) J. Lehmann. Sept.
1958. 57p.

The following properties have been determined in the
new cast state for uranium alloys containing 0.5, 1.0,
1.5, 2.0, and 3.0 per cent of molybdenum: micrographi-
cal aspect, crystalline structure, thermal expansion,
mechanical characteristics, behaviour when subjected
to cyclic temperature variations, and heat treatment.
The transformation curves have been established for
continuous cooling at rates varying between 2.5 and
200°C per minute, using a dilatation method for the
alloys containing 1.0, 2.0, and 3.0 per cent Mo. T.T.T.
curves have been traced for a the 0.5 and 1.0 per cent
Mo alloys and the Ms points determined for the alloys
containing 2.0 and 3.0 per cent Mo. In this way it has
been possible to show the different results of trans-
formation, brought about either by nucleation and diffu-
sion or by shear. The alloy containing 1 per cent Mo,
gives two martensites α' and α'' and the alloys contain-
ing 2 and 3 per cent Mo give one martensite with a band
structure. (auth)

617   DP-376
Du Pont de Nemours (E. L) & Co. Savannah River
    Lab., Aiken, S. C.
MECHANICAL PROPERTIES OF URANIUM PLATE.
George R. Caskey, Jr. June 1959. 22p. Contract
AT(07-2)-1. OTS.

Hot-rolled uranium plate exhibited a pronounced di-
rectionality in mechanical properties which was re-
duced but not eliminated by beta transformation. Re-
sults of tensile, bend, impact, and hardness tests made
at room temperature are summarized for both hot-
rolled and beta-transformed uranium plate. Significant
differences in mechanical properties existed between
ten lots of uranium plate processed under similar con-
ditions. Composition and processing data were inade-
quate to assign causes for the variations. (auth)

618   KAPL-M-HOS-7
Knolls Atomic Power Lab., Schenectady, N. Y.
PROPERTIES OF BERYLLIUM METAL. Henry Suss.
Sept. 9, 1959. 15p. OTS.

Data on the pertinent characteristics and properties
of beryllium are reviewed for possible application in
the nuclear core region in a pressurized water reactor.
(J.E.D.)

619   LMSD-288005
Lockheed Aircraft Corp. Missiles and Space Div.,
    Sunnyvale, Calif.
BERYLLIUM CRACK PROPAGATION AND EFFECTS
OF SURFACE CONDITION. Quarterly Progress Report
No. 3 covering [period] January 15, 1959 to May 20,
1959. M. Jacobson, W. Jahsman, and C. Matthews.
May 20, 1959. 57p. Contract AF33(616)-5978.

The preparation of machined specimens of beryllium
for testing and completion of test facilities are re-
viewed. The extent of surface damage caused by grind-
ing and milling operations was assessed by a taper-
section technique in which a specimen is mounted and

polished in such a manner that the vertical magnification of a cross section is four to five times as great as the horizontal magnification. The analysis was undertaken to obtain an understanding of the mechanism of crack propagation and the techniques which might be used to arrest propagation. (J.E.D.)

620   MAB-154-M(Vol. I)
National Research Council. Materials Advisory Board.
SUMMARY REPORT OF THE COMMITTEE ON REFRACTORY METALS. VOLUME I. SUMMARY.
Oct. 15, 1959. 40p. Contract DA-36-039-sc-76436.

A study was made of the refractory metals, Mo, Nb, W, Ta, Cr, V, Re, and the Pt group to identify the metals which offer the most attractive properties for service at temperatures above 2000°F in missiles and high-speed aircraft. The Refractory Metals Committee concluded that the most important metals are Mo, Nb, W, and Ta. (W.L.H.)

621   NASA-TN-D-69
National Aeronautics and Space Administration. Lewis
     Research Center, Cleveland.
THERMAL FATIGUE OF DUCTILE MATERIALS. III.
BEHAVIOR OF CRUCIBLE 422 STEEL. Francis J.
Clauss. Oct. 1959. 24p. OTS.

Behavior of crucible 422 steel in thermal fatigue and the effect of constrained and free thermal cycling on the subsequent stress-rupture life were studied. Specimens were alternately heated and cooled through a maximum cycle temperature from 1000 to 1500°F and a minimum cycle temperature of 200°F, both with and without constraint. The number of cycles to failure, changes in hardness and microstructure, and stress-rupture properties were studied as a function of the conditions of thermal cycling. Changes in stress-rupture behavior were judged on the basis of the life at 1100°F and 46,000 psi. (auth)

622   NRL-Memo-691
Naval Research Lab., Washington, D. C.
EXPLOSION-BULGE TEST PERFORMANCE OF MACHINE WELDED 1 INCH THICK HY-80 STEEL. P. P.
Puzak. Apr. 1957. 26p.

Explosion-bulge tests were conducted at 0°F to evaluate the performance of machine welded HY-80 steel intended for submarine hull construction. Three types of welding methods were used to produce the weldments: (1) inert-gas-shielded metal-arc (Code C); (2) submerged arc (Code D); and (3) submerged arc (Code E). The performance of automatic weldments involving inert-gas-shielded metal-arc processes were shown to be satisfactory for applications based on "military service" loading conditions. Automatic weldments involving submerged arc processes (Code B and Code C) were characterized by high brittleness at 0°F of either the weld or HAZ. At their present state of development, submerged arc processes are not considered suitable for HY-80 applications based on "military service" loading conditions. (auth)

623   USBM-U-250
Bureau of Mines. Northwest Electrodevelopment Experiment Station, Albany, Oreg.
HARDNESS OF ZIRCONIUM AS A FUNCTION OF CONTAMINATION CONTENT. P. C. Magnusson. Jan. 18, 1957. Changed from OFFICIAL USE ONLY Oct. 20, 1959. 25p. OTS.

In this problem, analytical data and hardness measurements of a large number of zirconium ingots were processed by advanced computing machinery in an attempt to define the correlation between hardness and various contaminating elements. Results indicate the definite influence of oxygen, silicon, and possibly chromium. The wide divergence of values of partial correlation coefficients in the several groups of data treated indicates uncertainty in the technique, and the need for further study of the problem. (auth)

624   WADC-TR-59-172
Case Inst. of Tech., Cleveland.
HYDROGEN EMBRITTLEMENT IN STEELS, TITANIUM ALLOYS, AND SEVERAL FACE-CENTERED CUBIC ALLOYS. P. A. Blanchard, R. J. Quigg, F. W. Schaller, E. A. Steigerwald, and A. R. Troiano. Apr. 1959. 129p. Project No. 7021. Contract AF33(616)-3431.

This report, which describes the influence of hydrogen on the mechanical properties of high strength steel, titanium and face-centered cubic metals, is divided into three sections. Delayed Failure In High Strength Steel. The initiation of localized cracking in a hydrogenated high strength steel specimen was found to be dependent on the development of a critical hydrogen concentration and relatively insensitive to the magnitude of the applied stress. The stress played an essential role in the delayed failure process by providing the means for grouping the hydrogen. Assuming that the rate of stress-induced diffusion was a direct function of the applied stress, the predicted relationship between incubation time and stress agreed reasonably well with experimental data. Hydrogen Embrittlement and Strain Aging In Titanium Alloys. Low Strain rate embrittlement in titanium alloys can be classified as a strain aging phenomenon. Prestraining and aging an alpha-beta titanium alloy resulted in a ductility minimum at some intermediate aging time. It appears that hydrogen migrates to a region of inhomogeneous strain, where a high stress state exists, and creates this embrittlement. The restoration of ductility at long aging times was attributed to recovery with subsequent redistribution of hydrogen. Low strain rate hydrogen embrittlement was obtained for an alpha alloy and a beta alloy. Hydrogen in small quantities seemed to aid creep resistance in the alpha alloy. The beta alloy was resistant to nominal quantities of hydrogen (420 ppm), but did show embrittlement at higher levels. Hydrogen Embrittlement of Several Face-Centered Cubic Alloys. The hydrogen embrittlement of austenitic $Ni-Cr-Fe$ alloys and OFHC copper has been investigated. $Ni-Cr-Fe$ alloys were embrittled by hydrogen and their embrittlement was demonstrated to be of the same nature as that of steel. A qualitative mechanism was presented which indicated that only the transition metals should be capable of conventional hydrogen embrittlement. This mechanism also accounted for the observed decrease of embrittlement in the austenitic $Ni-Cr-Fe$ alloys with increasing $(Fe + Cr)$ content. (auth)

625
THE CRYSTAL STRUCTURES OF $NbBe_2$ AND $NbBe_3$.
Donald E. Sands, Allan Zalkin, and Oscar H. Krikorian (Univ. of California, Livermore). Acta Cryst. 12, 461-64(1959) June.

$NbBe_2$ has a face-centered cubic cell, a = 6.535 A; the space group is Fd3m; and there are eight formula units in the unit cell. Each niobium atom is surrounded by 12 Be atoms at 2.71 A and 4 Nb atoms at 2.83 A. Each beryllium atom has 6 Nb atoms at 2.71 A and 6 Be atoms at 2.31 A as nearest neighbors. $NbBe_3$ has a rhombohedral cell with a = 7.495 A, $\alpha = 35.43°$; the space group is R3m, and there are three formula units

in the unit cell. There are two kinds of niobium atoms. Nb_I has 18 Be and 2 Nb nearest neighbors at average distances of 2.78 A and 2.95 A, respectively; Nb_{II} has 12 Be and 4 Nb nearest neighbors at average distances of 2.64 A and 2.88 A, respectively. (auth)

626

LAVES PHASE COMPOUNDS OF RARE EARTHS AND OF HAFNIUM WITH NOBLE METALS. Vera B. Compton and Bernd T. Matthias (Bell Telephone Labs., Inc., Murray Hill, N. J.). Acta Cryst. 12, 651-4(1959) Sept.

The compounds $ScIr_2$, YAl_2, YRh_2, YIr_2, YPt_2 $LaRu_2$, $LaRh_2$, $LaOs_2$, $LaIr_2$, $LaPt_2$, $CeRu_2$, $CeRh_2$, $CeOs_2$, $CeIr_2$, $PrRu_2$, $PrRh_2$, $PrOs_2$, $PrIr_2$, $PrPt_2$, $NdRu_2$, $NdRh_2$, $NdIr_2$, $NdPt_2$, $GdRh_2$, $GdIr_2$, and $GdPt_2$ are cubic Laves phases, $MgCu_2$ structure (C15). The space group is O_h^7-Fd3m with 8 formula weights in the unit cell. Lattice constants for these compounds are reported. The compounds $HfRe_2$, $HfOs_2$, $ScRu_2$, $ScOs_2$, YRu_2, YRe_2, YOs_2, $PrOs_2$, $NdOs_2$, $SmOs_2$, $GdRu_2$, $GdOs_2$, $ErRu_2$, $LuRu_2$, and $LuOs_2$ are hexagonal Laves phases, $MgZn_2$ structure (C14). The space group is $D_{6h}^4-P6_3/mmc$ with 4 formula weights in the unit cell. Lattice constants are reported. Both the cubic and hexagonal Laves phases were determined by the powder diffraction method. The superconducting transition temperatures for $ScRu_2$, $ScOs_2$, $ScIr_2$, YRu_2, YRe_2, YOs_2, YIr_2, YPt_2, $LaRu_2$ $LaOs_2$, $CeRu_2$, $LuOs_2$, $HfRe_2$, and $HfOs_2$ are reported. Ferromagnetic transition temperatures are given for the praseodymium, neodymium and gadolinium compounds and for $SmOs_2$. (auth)

627

THE CRYSTAL STRUCTURE OF UPt_2. B. A. Hatt and G. I. Williams (Fulmer Research Inst., Ltd., Stoke Poges, Bucks, Eng.). Acta Cryst. 12, 655-7(1959) Sept.

The crystal structure of UPt_2 was determined as orthorhombic, space group Ama2 with a = 5.60, b = 9.68, and c = 4.12 A. The similarity between this structure and UPt_3 is shown. (auth)

628

THE CRYSTAL STRUCTURE OF $ZrAl_2$. C. G. Wilson (Royal Military Coll. of Science, Shrivenham, Berks, Eng.). Acta Cryst. 12, 660-62(1959) Sept.

The crystal structure of $ZrAl_2$ was determined from powder samples and imperfect single crystals. The unit cell is hexagonal with a = 5.282, c = 8.748 A; c/a = 1.656. There are four $ZrAl_2$ units per cell. The calculated density is 4.56 gcm^{-3}. The space group is $P6_3/mmc$. The structure is a Laves phase of the C_{14}, $MgZn_2$ type. The contraction of the Al substructure and the expansion of the Zr substructure support the general conclusions about the constitution of Laves phases. (auth)

629

TRANSITION ELEMENT-RARE EARTH COMPOUNDS WITH THE Cu_5Ca STRUCTURE. J. H. Wernick and S. Geller (Bell Telephone Labs., Inc., Murray Hill, N. J.). Acta Cryst. 12, 662-65(1959) Sept.

A number of new B_5A compounds, with A a rare earth or yttrium and B a transition element, Co, Ni, or Cu, having the Cu_5Ca structure, were prepared. In most of the compounds, the interatomic distances are normal. However, Ce appears to have a valence substantially greater than three. Also, in Co_5Pr, Pr appears to have a valence slightly greater than three. (auth)

630

THE EFFECT OF SEGREGATION ON THE DIFFRACTION FROM A FACE-CENTRED CUBIC ALLOY WITH DEFORMATION FAULTS. B. T. M. Willis (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Acta Cryst. 12, 683-9(1959) Sept.

The Paterson theory of x-ray scattering from a face-centered cubic structure with deformation faults is extended to include the case of a f.c.c. alloy, in which segregation of the alloy components takes place at the faults. The principal effect of segregation is to make the reflections asymmetrical. It is possible that this asymmetry could be detected in the powder lines of certain cold-worked alloys. (auth)

631

THE CRYSTAL STRUCTURES OF $PuNi_3$ AND $CeNi_3$. Don T. Cromer and Clayton E. Olsen (Los Alamos Scientific Lab., N. Mex.). Acta Cryst. 12, 689-94(1959) Sept.

The structure of $PuNi_3$ and the structure and composition of $CeNi_3$ were determined by single crystal x-ray methods. $PuNi_3$ has three formula units in a rhombohedral unit cell with a = 6.22 A and $\alpha = 33°\ 44'$, probable space group R3m. $CeNi_3$ has six formula units in a hexagonal cell with a = 4.98 and c = 16.54 A, probable space group $P6_3/mmc$. These structures are both derived from stacking single layers of the MNi_5 structure ($CaCu_5$-type) and double layers of the MNi_2 structure (Cu_2Mg-type). (auth)

632

ON THE CRYSTAL STRUCTURE OF PROTACTINIUM METAL. Jerry Donohue (Univ. of Southern California, Los Angeles). Acta Cryst. 12, 697-8(1959) Sept.

The (110) planes of the tetragonal structure reported for protactinium metal show a nearly hexagonal distribution of atoms. It is suggested that the protactinium structure may be orthorhombic, pseudo-hexagonal, and pseudo-tetragonal such that the ratio $A_1 : A_3$ is exactly $\sqrt{3}$, but $A_1 \neq A_2$. In the orthorhombic structure each atom has six neighbors at 3.214 A and four at 3.235 A. (C.J.G.)

633

ON THE CRYSTAL STRUCTURE OF PROTACTINIUM METAL. W. H. Zachariasen (Univ. of Chicago and Argonne National Lab., Lemont, Ill.). Acta Cryst. 12, 698-700(1959) Sept.

It was proposed by Donohue that protactinium has an orthorhombic structure. Examinations of protactinium metal films reveal cell dimensions $a_1 = 3.932 \pm 0.003$ A and $a_3 = 3.238 \pm 0.003$ A. Lattice constants for PaO and PaO_2 and film shrinkage effects were used in corrections. It is concluded that the orthorhombic structure for protactinium metal proposed by Donohue must be rejected as incorrect in favor of the tetragonal structure. (C.J.G.)

634

CRYSTAL STRUCTURES OF $ZrBe_5$ AND Zr_2Be_{17}. Allan Zalkin, Ray G. Bedford, and Donald E. Sands (Univ. of California, Livermore). Acta Cryst. 12, 700(1959) Sept.

Metal powders of Be-Zr compounds were heated to 1600°C, crushed and reheated. The resulting products were studied by x-ray-diffraction powder methods and two new phases, $ZrBe_5$ and Zr_2Be_{17}, were determined. $ZrBe_5$ has a hexagonal cell with dimensions: a = 4.564 ± 0.002 and c = 3.485 ± 0.002 A. The structure is the $CaZn_5$ type with space group D_{6h}^1-P6/mmm and x-ray density 3.60 g cm^{-3}. Zr_2Be_{17} has a rhombohedral cell with a = 5.694 ± 0.005 A and $\alpha = 83.05 \pm 0.02°$. The triply primitive hexagonal cell has a = 7.548 ± 0.004 and c = 10.997 ± 0.010 A. The structure is isomorphous of

the Nb_2Be_{17} type with space group $R\bar{3}m$ and x-ray density 3.081 g cm^{-3}. (C.J.G.)

635

A NEW INTERMEDIATE PHASE IN THE NIOBIUM—ALUMINUM SYSTEM. C. R. McKinsey and G. M. Faulring (Union Carbide Metals Co., Niagara Falls, N. Y.). Acta Cryst. 12, 701-2(1959) Sept.

Corenzwit (1959) has reported the existence of an NbAl compound tentatively identified as a sigma phase having an Al content greater than Nb_3Al. X-ray-diffraction data are reported which confirm the sigma phase and place its composition at ~34 at. % Al(Nb_2Al). (D.E.B.)

636

THE CRYSTAL STRUCTURE OF Nb_2Be_{17}. Allan Zalkin, Donald E. Sands, and Oscar H. Krikorian (Univ. of California, Livermore). Acta Cryst. 12, 713-15(1959) Oct.

Nb_2Be_{17} is rhombohedral with a = 5.599 A, α = 82.84° The dimensions of the triply primitive hexagonal cell are a = 7.409, c = 10.84 Å. The space group is $R\bar{3}m$, and there is one Nb_2Be_{17} unit in the rhombohedral cell. Each Nb atoms has 19 Be neighbors at 2.57 to 2.85 A (2.72 A average). There are four types of Be atoms: Be_I has 1 Nb neighbor at 2.57 and 13 Be at 2.23 to 2.47 A; Be_{II} has 2 Nb at 2.85 and 10 Be at 2.13 to 2.25 A; Be_{III} has 2 Nb at 2.62 and 10 Be at 2.13 to 2.47 A; Be_{IV} has 3 Nb at 2.68, 2.76, and 2.84 Å and 9 Be at 2.10 to 2.31 A. (auth)

637

THE CRYSTALLOGRAPHY OF THE β-α TRANSFORMATION IN ZIRCONIUM AND IN TWO TITANIUM—MOLYBDENUM ALLOYS. P. Gaunt (The University, Sheffield, Eng.) and J. W. Christian (University Museum, Oxford). Acta Met. 7, 534-43(1959) Aug.

The habit planes and orientation relationships associated with the transformation were studied in two specimens of crystal bar zirconium. The results are very similar to those of earlier workers for titanium, but the habit planes lie a little nearer to the (001) to (111) boundary and the $(11\bar{2}0)_\alpha$ pole is displaced a little further from $(11\bar{1})$ towards $(1\bar{1}0)$ than in titanium. The results are compared with the predictions of the Bowles—Mackenzie theory; as with titanium, best agreement is obtained with a type A (α^+,ω^+) solution, but in the present work it is not possible to obtain exact agreement for both orientations and habit planes. X-ray and kinetic observations both show that deformation accompanying transformation is much more severe in zirconium than in titanium, possibly as a result of a larger volume change, and the discrepancies may be due to the accommodation stresses. The habit planes and shape deformations were determined for stress-induced martensite in quenched titanium alloys containing 11% and 12.5% molybdenum. In the 12.5% alloy, only (344) type martensite was produced by stress, but both (334) and (344) types were produced in the other alloy, with the (334) predominating. The observed shear directions for the (334) martensite agreed with the predictions of the type A (α^+,ω^+) solution. A tentative orientation relation was obtained for one plate of (344) martensite; the present theory of this type of transformation is briefly discussed. (auth)

638

THERMODYNAMICS OF LIQUID Mg—Bi ALLOYS. J. J. Egan (Brookhaven National Lab., Upton, N. Y.). Acta Met. 7, 560-4(1959) Aug.

Thermodynamic studies on liquid Mg—Bi alloys were carried out using the emf method. A cell is described, suitable for measuring Mg activities in this system. Values of the excess partial molar free energy, the relative partial molar free energy, entropy, and enthalpy are listed along with the corresponding integral quantities. The results are compared with previous vapor pressure and calorimetric measurements as well as investigations of the phase diagram. Wagner's interpretation in terms of electronic constitution is consistent with the present data. (auth)

639

THE CHARACTERISTIC DISINTEGRATION OF AGED IRON IN ION BOMBARDMENT. Alois Mašín (Research Inst. of Commerce, Prague) and Vladimir Havel (Research Inst. of Metallurgy of Iron, Prague). Acta Phys. Acad. Sci. Hung. 10, 135-47(1959). (In German)

The basic principles of the characteristic disintegration of iron in ion bombardment were solved. It is shown that it is a matter of a section of slip bands, which are made visible by ion bombardment. The visualization is in direct relationship with the age of the iron. Its origin comes from the presence of carbon and nitrogen atoms in these slip bands, which increase with the age of the metal. The significance of the disintegration for studies of aging kinetics after hardening is discussed. (tr-auth)

640

CONTRIBUTIONS FROM THERMAL LATTICE DEFECTS TO THE EXPANSION OF SOLID AND LIQUID METALS. G. Borelius (Royal Inst. of Tech., Stockholm). Arkiv Fysik 16, 119-28(1959).

Previously determined experimental results on the energy content of solid Au, Ag, Cu, and Al are analyzed and a discussion of their thermal expansion, including expansion at the melting point and in the liquid state, is given. A phenomenological analysis is presented on the contributions from thermal lattice defects to the expansion of solid and liquid metals. (C.J.G.)

641

LOW-TEMPERATURE ELECTRIC CONDUCTIVITY OF ZONE-MELTED ZIRCONIUM. Louis Renucci, Jean-Paul Langeron, and Pierre Lehr. Compt. rend. 249, 1113-15(1959) Sept. 28. (In French)

Zirconium purified by zone melting recrystallizes at a temperature lower by 180°C than that of the parting metal. The effects of purity of metal on the evolution to a state recrystallized in the α state were also investigated. (T.R.H.)

642

THE INFLUENCE OF BORON ON THE NATURE OF CARBIDE SEPARATION IN AUSTENITIC STEELS DURING TEMPERING. V. V. Levitin and V. I. Syreyshchikova. Fiz. Met. i Metalloved. Akad. Nauk S.S.S.R., Ural'. Filail. 7, 308-10(1959).

Heating of austenitic stainless steels containing carbon in solid solution up to temperatures of 500 to 800°C causes formation of chromium carbide in the grain boundaries, as a result of which the steel ceases to be resistant to intercrystalline corrosion. The influence of small additions of B on the nature of the separation of the carbide phase during tempering and on the tendency of Cr—Mn—N: Steel containing N to intercrystalline corrosion, was investigated. (TCO—W.L.H.)

643

THE INFLUENCE OF RATE OF HEATING ON TRANSFORMATIONS IN STEEL DURING TEMPERING. A. P.

Gulyaev and M. V. Taratorina (Central Scientific Research Inst. of Tech. and Machine Building). Fiz. Metal. i Metalloved. 7, 544-50(1959) Apr. (In Russian)

Dilatometric and x-ray-diffraction analysis and optical and microscopic studies were employed in determining structural changes taking place with fast-rate heating during high-carbon steel tempering in water at 1100°C. Graphs are plotted of phase transformation at heating rates of 2.7×10^{-2} to 9×10^2 °/sec. The fast rate of heating depresses the first stage of transformation; the temperature of the first transition shifts when the heating rate exceeds ~500°/sec. First stage transition starts at 330 to 350° and 750°/sec; at 900°/sec it begins at 430 to 450°. Electron microscopy showed less carbide parting and smaller carbide particles with fast-rate heating. Martensite disintegration, with carbide particle dispersion and undisturbed areas, was observed at a 750°/sec heating rate and tempering at 350°C. The second transformation (disintegration of austenite) takes place at all observed heating rates, but the positive dilatometric effect (expansion) is not observed at rates exceeding 100°/sec. However, a complete phase transformation can be achieved at any heating rate with suitable tempering temperatures. (R.V.J.)

644

CREEP OF METALS AND ALLOYS. 6. DIFFUSION CREEP IN TWO COMPONENT SOLID SOLUTIONS. Ya. E. Geguzin (Khar'kov State Univ.). Fiz. Metal. i Metalloved. 7, 572-85(1959) Apr. (In Russian)

The rate of fusion creep is described by three types of equilibrium diagrams of Au–Ni, Cu–Ni, and Pb–Sn alloys. (R.V.J.)

645

STRUCTURAL CHANGES OF Ni AND Ti SOLID SOLUTIONS IN Ni AT HIGH DEFORMATION TEMPERATURES. V. M. Rosenberg and L. V. Gradova (Central Scientific Research Inst. of Ferrous Metallurgy). Fiz. Metal. i Metalloved. Akad. Nauk S.S.S.R., Ural Filial 7, 722-31(1959) May. (In Russian)

Structural changes of nickel and solid solutions of titanium in nickel during deformation at 700 to 900° are studied in alloys annealed at 1200°. (R.V.J.)

646

CHANGES IN FINE CRYSTALLINE STRUCTURE OF NIOBIUM WHEN STRENGTHENED BY PLASTIC DEFORMATION. L. I. Lysak and L. V. Tikhonov (Inst. of Metal Physics, Academy of Sciences, Ukrainian SSR). Fiz. Metal. i Metalloved. Akad. Nauk S.S.S.R., Ural Filial 7, 757-65(1959) May. (In Russian)

Variations in second and third type distortions in the niobium crystal lattice, the dimensions of coherent regions, and the texture and stability characteristics in cold deformation hardening are studied.

647

DIFFUSION OF Ni–Ti ALLOYS. A. Ya. Shinyaev (Baikov Inst. of Metallurgy, Academy of Sciences, USSR). Fiz. Metal. i Metalloved. 7, 875-8(1959) June. (In Russian)

The diffusion of iron in cast nickel–titanium alloys at 950 to 1247° was studied. The minimum diffusion factor was found on the plotted composition curve. At low temperatures the minimum factor shifts closer to the solubility point, at elevated temperatures it is closer to the region of diluted solid solutions. The maximum strength of the alloy at 950 to 1100° was found with Ti content of 8 wt. %. (R.V.J.)

648

TRANSFORMATIONS IN ALLOYED PERMALLOY. M. P. Ravdel and Ya. P. Selisskii (Central Scientific Research Inst. of Ferrous Metallurgy). Fiz. Metal. i Metalloved. 7, 885-92(1959) June. (In Russian)

Effects of alloying elements (Cr, Cu, Mn, Mo, Si, V, and W) on the ordering processes in Ni_3Fe were found by measuring the electroconductivity and magnetic properties and by dilatometric and thermometric analysis. (R.V.J.)

649

THE MECHANISM OF HIGH TEMPERATURE DEFORMATION OF Ni–Al AND Ni–Cu SOLID SOLUTIONS. V. I. Syutkina and E. S. Yakovleva (Inst. of Metal Physics, Academy of Sciences, USSR). Fiz. Metal. i Metalloved. 7, 929-36(1959) June. (In Russian)

Tests were carried out on the tensile deformation of Ni–Cu alloys at 400°, at the rate of 0.2%/sec for 2 and 12% expansion; and Ni–Al alloys at 700°, at the rate of 0.2%/sec for 2 and 12% expansion and 2%/hour for 2%. The presence of copper and aluminum retards grain boundary shifting during high temperature deformation. (R.V.J.)

650

THE SPECIFIC HEAT OF ZIRCONIUM BORIDE. A. N. Krestovnikov and M. S. Vendrikh. Izvest. Vysshikh Ucheb. Zavedenii, Razvedoch, Tsvetnoya Met., No. 1, 73-5(1958)

The average specific heats of Zr boride are given. The data are used to compile equations for the average and true specific and molecular heat capacities. The deviation of the values found from those calculated by the Maydel' equation (by the rule of additivity) is <10%.

651

STRENGTH PROPERTIES OF SINTERED ALUMINA IN RELATION TO POROSITY AND GRAIN SIZE. Ivan B. Cutler (Univ. of Utah, Salt Lake City). J. Am. Ceram. Soc. 40, 20-4(1957) Jan.

The strength properties of sintered alumina rods, as determined by modulus of rupture experiments, were measured for the purpose of finding the influence of grain size on strength. Sintering temperatures below and above the recrystallization temperature region were utilized in the fabrication of sintered alumina rods so that a wide variation of grain sizes could be tested. Porosity, measured as bulk density, had the largest influence on the moduli of rupture. No prominent change in strength could be observed as a result of recrystallization, but a minor decrease in strength could be attributed to an increase in void size or an increase in grain size. (auth)

652

THERMODYNAMIC PROPERTIES OF SOME LIQUID METAL ALLOYS. J. I. Guérassimov, A. V. Nikolskaia, and A. M. Evséev (Université Lomonossov, Moscow). J. chim. phys. 56, 641-8(1959) July. (In French)

The emf and Knudsen effusion methods were used to study the thermodynamic properties of Cd–Bi, Pb–Sn, Cu–Bi, Cu–Cd, and Cu–Sb alloys. The results are related to atomic structure, and it is concluded that it is possible to qualitatively estimate the structure of liquid alloys from thermodynamic data. Some treatment is given to probabilistic theory of order. (T.R.H.)

653

ALUMINUM–URANIUM ALLOYS, THEIR PROPERTIES, PREPARATION, AND COATING. Seller. Met. yadernoi

Energet. i Deĭstvie Obluchen. na Materialy (Moscow:
Gosudarst. Nauch.-Tekh. Lit. Chernoĭ i Tsvetnoĭ Met.)
Sbornik, 242-57(1956).   (Translated from Referat.
Zhur. Met. No. 1, 1957, p.192).

The physical properties of Al-U alloys (A) containing
up to 35% U were investigated. The A were prepared
by smelting in graphite or fireclay-graphite crucibles
with heating by a gas-air mixture or by the induction
method. A with a fine grain structure containing >20%
U were prepared by the powder-metallurgy method
using evaporated Al and UAl$_4$ and UAl$_2$ powder. Speci-
mens of the A were forged and hot- and cold-rolled.
Forging of A containing up to 20% U was carried out
at 550 to 600°C. A with 20 to 30% U were difficult to
forge while specimens with >30% U were not forgeable and
were rolled after hardening and coating with an Al
jacket. In cold-rolled A the maximum values for σ_b and
σ_s were attained with 9% U. Annealing or quenching at
550°C impairs the strength of all A. Aging produces
no appreciable changes in strength. Data on tensile
strength tests of A with 11.3 and 17.3% U at 150 and
300°C the results of heat conductivity and hardness
measurements during the aging process, and the linear
expansion coefficient of some A are adduced. It was
established that coating A with Al produces articles
with high corrosion resistance in water. Smelting,
machining, and coating of A with high U content are
difficult but possible. (TCO)

654

DECOMPOSITION OF RESIDUAL AND SUPER-COOLED
AUSTENITE IN ALLOYED STEELS. B. A. Apaev, S. N.
Krasotskaya, and V. N. Makarychev (Gor'kii Research
Inst. of Physics and Tech.). Metalloved. i Termichesk.
Obrabotka Metal. No. 6, 2-6(1959) June. (In Russian)

Decomposition kinetics of residual austenite in chro-
mium, molybdenum, tungsten, and vanadium alloyed
steels, diffusion annealed at 1200° for 6 hours, were
studied at 300 to 650°. Decomposition of super-cooled
austenite in steels annealed at 1100° was also studied
in melted tin at 300 to 700°. Comparative data are
tabulated and diagrams are plotted for residual and
super-cooled austenite decomposition in various steels.
(R.V.J.)

655

DECOMPOSITION KINETICS OF RESIDUAL AND
SUPER-COOLED AUSTENITE IN ALLOYED STEELS.
B. A. Apaev, S. N. Krasotskaya, and V. N. Makarychem
(Gor'kii Research Inst. of Physics and Tech.). Metal-
loved. i Termichesk. Obrabotka Metal. No. 6, 7-13
(1959) June. (In Russian)

The influence of partial intermediate transformation
of austenite on the subsequent transformation at lower
temperatures was tested with 53 x H3 (0.53% C, 1.1%
Cr, and 3.4% Ni) at T_1 = 405 and 365, and T_2 = 300 and
260°; the steel 60C2 (0.6% C and 2.3% Si) at T_1 = 400 and
350, and T_2 = 350 and 300°; and, 129G2 steel at T_1 = 365°
with subsequent T_2 = 300°. (R.V.J.)

656

REACTION OF NIOBIUM CARBIDE WITH COBALT.
E. A. Shchililina and I. N. Chaporova (All-Union
Scientific-Research Inst. of Hard Alloys). Metalloved.
i Termichesk. Obrabotka Metal. No. 6, 19-23(1959)
June. (In Russian)

Constitution diagrams plotted for NbC—Co showed a
similarity in niobium carbide and titanium carbide re-
actions with cobalt; both systems are eutectic with the

same maximum solid state diffusion point and melting
point. (R.V.J.)

657

LONG-TERM HEAT RESISTANCE OF NICKEL BASE
ALLOYS. E. E. Levin and E. M. Pivnik (Polzunov,
Central Research Inst. of Boiler Construction). Metal-
loved. i Termichesk. Obrabotka Metal. No. 6, 46-50
(1959) June. (In Russian)

The relationship between the α phase grain expansion
during annealing and the heat resistance of nickel base
alloys was studied. Tests were made on three types of
alloys (0.64% Al, 0.06% C, 14.8% Cr, 1.5% Nb, 1.69% Ti;
0.61% Al, 0.01% B, 0.03% C, 15.5% Cr, 1.28% Nb, 1.42%
Ti; 1.3% Al, 0.010% B, 0.03% C; 16.4% Cr, 1.10% Nb,
1.6% Ti) quenched in water at 1100°; annealing at 1000°
for 2 hr, 900° for 1 hr, 800° for 2 hr; and annealed at
750° for 20 hr and 700° for 48 hr. The rate of grain
growth is slowed by soaking at elevated temperatures.
Additions of boron intensify grain expansion while the
increase of aluminum content slows it. A certain rela-
tion was found between the grain expansion rate and the
duration of heat resistance. (R.V.J.)

658

ANNEALING EFFECTS ON AUSTENITIC STEEL PROP-
ERTIES. E. I. Uryupina (Central Scientific Research
Inst. of Machine Building). Metalloved. i Termichesk.
Obrabotka Metal. No. 6, 50-4(1959) June. (In Russian)

Effects of long-term annealing (900 to 1300°) on the
mechanical properties of austenite steel 1 × 1849T
(0.09% C, 16.80% Cr, 1.17% Mn, and 0.64% Ti) were in-
vestigated. (R.V.J.)

659

HEAT-RESISTANCE OF PERLITE STEEL TUBES.
T. S. Griboedova (Central Scientific Research Inst. of
Machine Building). Metalloved. i Termichesk. Obra-
botka Metal. No. 6, 55-8(1959) June. (In Russian)

The heat resistance of perlite tube steel 15 × 1M1F,
normalized at optimum working conditions of 1030 to
1050° and tempered at 700 to 720° for 5 hours, was
studied. The creep rate after normalization and tem-
pering at 570° under 6 kg/mm^2 was 1×10^{-5}%/hour.
Long-term stability was demonstrated at 570° with
10.5 kg/mm^2, at 585° with 9.3 kg/mm^2, and at 600° with
7.5 kg/mm^2. The examined tubes can be used in power
installations with steam parameters of 565 to 585° at
140 atm. (R.V.J.)

660

NEW DISCOVERIES IN BORIDING OF STEEL.
Panteleev. Narodnoye Khoz. Sovet. Latv., No. 1,
29-31(1958). (Translated from Referat. Zhur. Met.,
No. 12, 1958, p.113).

The formation of new eutectic and super-eutectic
layers (L) instead of continuous crystalline L obtained
in boriding (B) steel is reported. These L possess the
same hardness (1800−3575 microhardness units) as
the ordinary crystalline L, are free from internal
stresses, but are very brittle. Only one hour of B is
required to obtain an L 0.1 mm thick. To obtain an L
of the same depth without fusing requires several hours'
B. The blunting of the sharp edges of the article during
B when the L is fused is so slight that grinding to a
depth of 0.02-0.03 mm completely restores the edges.
The treatment consists essentially of B at the metling
temperature of the boron-steel eutectic with a certain
excessive liberation of nascent boron for a rapid satu-
ration of the L. This method affords warpless B of

asymmetric articles with a complex contour and has possibilities for early practical application.

661

THE INTERACTION BETWEEN NICKEL—VANADIUM ALLOYS AND REFRACTORIES. V. P. Yelyutin, Yu. A. Pavlov, and B. V. Glukhovtsev. Nauch. Doklady Vysshei Shkoly Met. No. 1, 87–92(1958).

The technology of high-temperature alloys, especially in regard to the removal of inclusions of non-metals or gases in alloys was investigated. Nickel-vanadium alloys were used as initial materials the melt which was produced at 1800 to 1900°. The melt of the nickel—vanadium alloys was carried out in crucibles of Al_2O_3, BeO, and ZrO_2 with different duration of storing. The analysis showed that the alloys were rich in gases such as 0.072 to 0.022% O_2 and 0.01 to 0.095% N_2. It was found that the high gas content of the alloys is caused by inclusion of the initial materials, especially the aluminum thermic vanadium. To determine a suitable refractory for the nickel-vanadium alloys the interaction between the alloys and the refractory was investigated. By means of radioactive indicators the character of the interaction between the refractory and the liquid metal alloy with a vanadium content of 30% was determined. ZrO_2 was used as refractory to which the radioactive isotope Zr^{95} was added. The investigations showed that non-metallic impurities can be avoided only if the melt is not overheated and is left in the state of melting for as short a period as possible. The reaction products were investigated also by means of x-ray structural analysis to explain the character of the interaction between the refractory and the liquid nickel-vanadium alloys. This analysis showed that in the interaction between the alloys and the refractory ZrO_2 is reduced to Zr. The character of the interaction between the alloys and the refractories of beryllium oxide was not explained by the x-ray structural analysis. Beryllium vapor is formed which also dissolves in the metal melt. Experiments on the interaction of nickel—vanadium alloys and Al_2O_3 were also carried out. The macro- and microscopic investigation of the surface of zirconium bricks showed that when the melt remains in the crucible for a longer period of storage the metal melt penetrates the ZrO_2. In melting beryllium and aluminum oxide in crucibles the interaction between the liquid metal and the refractory is much smaller. (TCO)

662

THE CHARACTERISTIC TEMPERATURES OF THE HEAT VIBRATION AND THE THERMAL EXPANSION OF SOME HIGH MELTING METALLIC PHASES. A. M. Belikov and Ya. S. Umanskii. Nauch. Doklady Vysshei Shkoly Met. No. 1, 192–7(1958).

Inclusion phases in the alloys of molybdenum with niobium and titanium were investigated. Nitrides of these elements were produced according to the powder metallurgical method in the nitrogen flow at 1000 to 1200°C. In these investigations the lattice constant and the quantity of m θ^2 of the composition of the alloys Mo–Nb and Mo–Ti were investigated. The quantity m θ^2 varies with the content of titanium or niobium in Mo the alloys. This variation of m θ^2 explains the strong interaction between the atoms of titanium and especially of niobium with atoms of molybdenum rich alloys. The values for m θ^2 in nitrides equal to those values of pure metals. From the investigation of the carbides TiC, ZrC, NbC, and WC it may be seen that these compounds have the same combining power as metals. Data are

given on the combining powers and coefficients of linear expansion of the listed metals and their metallic phases such as NbN, ZrN, Ta_2N, TiC, Mo_2C, and NbC. In the investigation of the carbides of molybdenum and tungsten as well as of all nitrides it was found that the constant of the heat vibrations changes only little as compared to pure iron. It is assumed that in all phases the electrons of carbon actively effect the structure of the d-orbits of the metals of the fourth and fifth group. The electric conductivity of the carbides of molybdenum and tungsten is lower than the electric conductivity of pure molybdenum and tungsten metals. (TCO)

663

THE MICROPOROSITY OF BERYLLIUM OXIDE POWDER. S. M. Astrakhantsev and Ya. S. Umanskii. Nauch. Doklady Vysshei Shkoly, Met. No. 3, 226–30(1958).

Beryllium oxide produced in the thermal decomposition of complex compounds is characterized by the low bulk weight and the inferior pressing properties. An investigation was made of the causes of the deterioration of the pressing properties of beryllium oxide. Beryllium oxide with a bulk weight of 0.107 g/cm^3 is pressed into briquets at a pressure of 1 to 1.5 t/cm^2. It was found that the amount of pressure applied does not change the properties of the pressed articles. The microporosity of the beryllium oxide sample was investigated as dependent on the sintering temperature. The main cause for the inferior pressing and the low bulk weight of beryllium oxide powder is the high microporosity of the sample. An increase of the density of beryllium oxide does not only bring about a decrease of the microporosity but also a change of the grain size. The properties of the initial beryllium were investigated by means of a small-angle x-ray analysis. (TCO)

664

CHANGES IN CERTAIN PHYSICAL PROPERTIES OF SUPERALLOYS OF THE Fe—Cr—Al SYSTEM DURING HIGH-TEMPERATURE ANNEAL. P. P. Kuz'menko and T. A. Ryabchun. Nauk Povidomlenyya Kyyiys'k Inst. No. 1, 33–4(1956). (Translated from Referat. Zhur. Met. No. 6, 1957, p.227).

An investigation was made of the influence of annealing time at 1200°C on the structure, lattice parameter, density, and corrosion resistance of heat-resistant alloys. It is established that the numbers of solid, brittle, and nonmagnetic inclusions of a new phase rise with anneal time. The resistance of the alloys to oxidation drops with increase in holding time. The cause of the change in properties is decomposition occurring during annealing, thus bringing the alloys to approximate a state of equilibrium. The change in chemical composition is a secondary factor in influencing the properties of the alloys.

665

THE DEFORMATION OF ALPHA URANIUM. B. R. Butcher (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Power 4, No. 42, 105–6(1959) Oct.

A review on the exact crystallographic mechanisms of deformation of alpha uranium is presented. It is noted that twinning decreases in importance in the deformation of uranium between 450 and 500°C. (C.J.G.)

666

ENRICHED BORON—TITANIUM DISPERSIONS. L. B. Prus, E. S. Byron, F. O. Von Plinsky, and S. W. Porembka (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng. 6, 167–73(1959) Sept.

Extrusion and fabrication characteristics of various titanium-enriched boron dispersions indicate that hot extrusion of uncompacted powders is a feasible method for producing these materials. Tensile and impact properties of dispersions containing 2.43, 3.4, and 3.8 w/o B^{10} show a decrease with increasing B^{10} concentration. Irradiation studies on these materials revealed that internal cracking results after thermal neutron exposures of approximately 4.6×10^{20} nvt and higher. Tensile properties of the dispersions were related directly to the exposure and resulting structure, however, no correlation was found between exposure and impact properties of these materials. (auth)

667

SOME PROPERTIES OF URANIUM–FISSION ALLOYS. S. T. Zegler and M. V. Nevitt (Argonne National Lab., Lemont, Ill.). Nuclear Sci. and Eng. **6**, 222–28(1959) Sept.

Hardness, density, and thermal expansion data are presented for alloys of uranium with certain fission-product elements. The elements are those expected to remain in a spent fuel from a fast reactor following pyrometallurgical refining. In cast and gamma quenched alloys the retention of the high-temperature gamma phase produces low hardness and low density. Thermal expansion behavior is dependent upon composition and prior thermal history. (auth)

668

THE INFLUENCE OF AGING ON THE COMPRESSIVE STRENGTH OF STEELS. Gy. Ziaja (Technische Universität, Budapest). Periodica Polytech. (Eng.) **3**. 147–56(1959). (In German)

The effects of aging on the compressive strength of steels were investigated on three different steels, one containing 0.06% Al. The results showed that the compressive strength undergoes no changes after aging and the conditions for the aging also had no effect on the results. The values obtained for the Al steel were slightly lower, but were within the deviation range. The compressive strength in cold working, which is caused by uniaxial stress, undergoes a characteristic decrease whose magnitude can be determined numerically in a simple fashion. (tr-auth)

669

THE EFFECT OF MAGNESIUM ON THE COMPRESSIVE STRENGTH OF ALUMINUM. L. Juhász (Technische Universität, Budapest). Periodica Polytech. (Eng.) **3**, 157–61(1959). (In German)

A relationship between the structure and compressive strength of alloys exists in the sense that the compressive strength of alloying elements non-soluble in each other varies linearly within the alloy series, whereas the compressive strength of solid solutions generally increases proportionally with the change in the lattice dimensions. In the aluminum–magnesium alloy series an increase of the compressive strength is observed up to the limit of the limited solubility, but it decreases sharply after that. The compressive strength for the aluminum–magnesium alloy series, therefore, has its highest value in solid solutions saturated in the equilibrium state. (tr-auth)

670

MAGNETIC SUSCEPTIBILITY OF CLOSE-PACKED HEXAGONAL GOLD-INDIUM ALLOYS. T. B. Massalski (Univ. of Birmingham, Eng.) and L. Meyer and D. Weiner (Univ. of Chicago). Phys. Rev. **115**, 301–2(1959) July 15.

The magnetic susceptibility of close-packed hexagonal gold-indium alloys has been measured at 300, 77, 4.2, and 1.2°K. The susceptibility data show a striking similarity to the c-axis spacing, exhibiting a maximum at about 19 at.% In, consistent with a model assuming that the Fermi surfaces touch the Brillouin zone face (0002) at this concentration. (auth)

671

PIEZORESISTANCE OF n-TYPE GERMANIUM. H. Fritzsche (Univ. of Chicago). Phys. Rev. **115**, 336–45(1959) July 15.

The change of electrical resistance in uniaxial tension was measured over the range 6 to 300°K for several single-crystal specimens of germanium doped with arsenic or antimony. The tensile stress was varied from 1×10^7 to 5×10^8 dynes/cm^2. Particularly at low temperatures where most of the carriers are bound to impurity centers, the piezoresistance of the conduction band departs strongly from linearity in stress. For the large piezoresistance effects measured with uniaxial stress in [110] direction, these departures depend in size and magnitude on the kind of donor impurity. It is shown that if the strain-induced shift of the Fermi energy is taken into consideration these effects are to be expected from the electron transfer model, which attributes the large piezoresistance to the strain-induced changes of the electron concentrations in the various conduction band valleys. Theoretical predictions concerning the lowest donor states, a one-fold 1s-like ground state and a higher lying three-fold state, are verified for As in Ge. The energy separation between these two states is $(4.10 \pm 0.15) \times 10^{-3}$ ev for As and at least by an order of magnitude smaller for Sb in Ge. The deformation potential constant (conduction band) for pure shear strain was found to be $E_2 = 19.2 \pm 0.4$ ev at 6.6°K. The mobility anisotropy of a valley was found to decrease with decreasing T because of anisotropic scattering by ionized impurities. (auth)

672

KINETICS OF VACANCY MOTION IN HIGH-PURITY ALUMINUM. Warren DeSorbo and David Turnbull (General Electric Research Co., Schenectady, N. Y.). Phys. Rev. **115**, 560–3(1959) Aug. 1.

It is shown that in very high-purity aluminum, Al_{II}, the rate of vacancy annealing depends on vacancy concentration and annealing temperature but is independent of the temperature T_i of vacancy injection per se. The rate can be described as the sum of first and second order components. The first order component becomes most prominent at a monovacancy concentration estimated to be 10^{-6} atom fraction. It is shown that the results are consistent with the Koehler-Seitz-Bauerle dissociative mechanism. The activation energy for diffusion of monovacancies in Al_{II} is found to be 0.65 ± 0.06 ev. This, combined with earlier results on the formation energy of vacancies, gives 1.44 ± 0.11 ev for the activation energy for self-diffusion in aluminum by a monovacancy mechanism. In zone-refined aluminum, Al_I, of lesser purity, the rate of vacancy annealing depends upon T_i per se and falls off more rapidly with decreasing vacancy concentration than in Al_{II}. Two hypotheses for the impurity effects are considered, namely: (1) trapping of vacancies by impurity atoms and (2) inhibition of dislocation climb by adsorbed impurities. (auth)

673

EFFECT OF COMBINED CHEMICAL AND HEAT

TREATMENT ON HEAT RESISTANCE OF ALLOYS.
V. P. Yelyutin, Ye. I. Mozzhukhin, and V. I. Shulepov.
Sbornik Moskov. Inst. Stali, No. 38, 427-32(1958).
(Translated from Referat. Zhur. Met. No. 1, 1959,
p.75).

The effect of combined chemical and heat treatment
(CHT) of the surface of specimens of a TiC base alloy
cemented with a NiAl compound containing 54 atom-%
Ni and 60 atom-% of metallic Nb, Zr, Cr, or Be on the
resistance to scale formation at 1150 to 1250°C were
investigated. The CHT consisted of annealing of the
specimens covered with a 50:50 mixture of ZrO_2 and
alloying metal and 1% NH_4Cl in an H_2 atmosphere at
1500°C. Saturation of the surface with niobium and
zirconium does not improve the resistance to scale
formation of TiC-NiAl alloys. CHT with beryllium
and chromium increases the heat resistance by 1900
and 200%, respectively. It is noted that a change in
the procedure of saturation of the alloy surface with
chromium has no effect on its resistance to scale for-
mation. However, CHT conditions should remain con-
stant (1500° temperature for 0.5 hour) for Be, because
any difference in the interaction between Be and TiC
and NiAl results in a different concentration of Be in
these phases. During longer CHT Be reacts predomi-
nantly with the NiAl and that the TiC grains become
exposed, which lowers the resistance to scale forma-
tion of these alloys. (TCO)

674
CLEAVAGE FRACTURE IN A Cr-Ni-Mo STEEL.
A. V. Mikul'chik and Sh. I. Kats. Sbornik Statei Ural'
Zavod Tyazh. Mashinostroeniya im. S. Ordzhonikidze,
No. 5, 103-110(1958). (Translated from Referat. Zhur.
Met., No.3, 1959, p.210).

In order to evaluate the effect of technological factors
of smelting and casting on the susceptibility of Cr-Ni-
Mo steel 34KhNZM to cleavage fracture (CF), six
forgings were investigated. The investigations dealt
with the following factors: macro and microstructure,
the nature of the fracture, incidence of nonmetallic
inclusions, and the mechanical properties of the forgings.
It was established that CF is observed only in the upper
and central portions of the forgings and that it is inde-
pendent of the concentration of nonmetallic inclusions
and gases in the steel. CF is caused by a coarse den-
dritic structure which had formed as a result of exces-
sively high casting temperatures and which was not
refined in the course of forging.

675
INVESTIGATION OF BOUNDARY AND VOLUMETRIC
DIFFUSION PROCESSES BY THE METHOD OF AB-
SORPTION OF BETA-RADIATION. V. T. Borisov,
V. M. Golikov, and G. V. Shcherbedinskii. Sbornik
Trudov Inst. Metalloved. i Fiz. Metallov. Tsentr. Nauk
Issledovatel. Inst. Chernoi Met. 5, 383-96(1958).
(Translated from Referat. Zhur. Met. No. 1, 1959,
p.202).

Description of an experimental apparatus employing
radioactive isotopes in studying grain-boundary diffu-
sion processes by the radiation-absorption method is
presented. The specimen is maintained in an Ar atmos-
phere and is a-c heated. An Al filter 10 μ thick is placed
between the specimen and the radiation counter. A
method permitting the determination of the coefficient
of absorption of β-radiation is presented. An apparatus
capable of depositing radioactive layers by means of
spraying is described, and a method for the determina-
tion of the layer thickness is given.

676
INVESTIGATION OF THE BISMUTH-RUBIDIUM
SYSTEM. T. A. Mingazin. Uchenye Zapiski Turkm.
Univ., No. 11, 231-9(1957). (Translated from Referat.
Zhur. Met., No. 12, 1958, p.151).

The investigation of alloys of the Bi-Rb system was
carried out by means of a special apparatus which
permits one to weigh microspecimens of Rb, prepare
alloys, obtain thermographic curves, take test samples
for x ray analysis, and measure the density of small
amounts of alloys under hermetically sealed conditions.
On the Bi side the eutectic occurs with 4.5% Rb at 250°C;
the second phase of this eutectic is a Bi_2Rb compound
with a melting point ~650°, a density of 7.5 g/cc, and
has a cubic lattice. On the Rb side there is a eutectic
with a melting point close to that of Rb.

677
AN INVESTIGATION OF FATIGUE FAILURE OF AL-
LOYS AT ELEVATED TEMPERATURES. V. A.
Parfenov. Vsesoyuz. Sbornik Issledovatel. Zharoprochn.
Splavam. Moscow, Akad. Nauk S.S.S.R., 2, 211-27(1957).
(Translated from Referat. Zhur. Mek. No. 10, 1958,
p.156.)

An investigation was made of the fatigue failure,
of high-alloyed, heat-resistant alloys. EI437B, EI617,
and EI602. During processes preceding the fatigue
failure of a specimen a prominent role is played by
the vacancies which acquire an ability to move about
rapidly and to unite with each other at elevated tem-
peratures, thus greatly increasing the rate of diffusion of
atoms and effecting rapid disintegration of the solid
solution. Surface oxidation of the alloy is harmful; its
effects manifest themselves in a reduction of the re-
crystallization temperature of the layer immediately
below the oxide film and in the formation of stress con-
centrations. The endurance of work-hardened speci-
mens is increased if no recrystallization occurs during
testing and if the compressive stresses are not relieved.
Studies of the progress of plastic slips occurring dur-
ing repeated alternating deflection demonstrated that a
smaller number of slip lines appear during reverse
than during the initial bending of a plate, and that, con-
sequently, the deformation proceeds, in part, along the
initial slip planes. The relative plastic deformation of
specimens during fatigue testing is several orders
higher than the deformation produced during creep and
stress-rupture testing. The nature of failure of an alloy
is determined by the magnitude of the relative deforma-
tion. X-ray-diffraction study of specimens of the EI602
alloy, which had been subjected to fatigue tests under
conditions of an asymmetrical tension cycle at tempera-
tures of 700, 800, and 830°C, revealed blurring of in-
terference lines and a reduction of their intensity.

678
ISSLEDOVANIYE RASSEYANIYA KHARAKTERISTIK
VYNOSLIVOSTI KONSTRUKTSIONNYKH ALYUMINI-
YEVYKH SPLAVOV V SVYAZI S TEKHNOLOGIYEY
IKH PROIZVODSTVA. (Research on the Scattering of
Endurance Characteristics of Structural Aluminum
Alloys in Connection with Production Technology).
S. V. Serensen, M. N. Stepnov, V. P. Kogayev, and
Ye. V. Giatsintov. Moscow, Oborongiz, 1958. 122p.

Methods of fatigue testing to determine the scattering
characteristics of fatigue-life indexes of aluminum
alloys are presented. The effects of pressing, forging,
and stamping are described. Data on stressed state
during tests are included. Effect of specimen properties
on scattering fatigue-life indexes is described. Probable

stability characteristics of fatigue-strength properties and basic data on the effects of alloy deformation and conditions of thermal treatment, etc., were obtained. Considerable attention was given to testing methods and to systems for working out results on the basis of currently-used statistical presentations. The article suggests that these methods should be widely applied in laboratory practice in testing structural alloys for strength. (TCO)

679

A HEAT-RESISTANT DEFORMABLE MAGNESIUM ALLOY. T. V. Lebedeva and I. G. Kovalev. U.S.S.R. Patent 112487. Byull. Izobret., 1958, No. 4.

A heat-resistant, deformable magnesium alloy is described which contains 2 to 6% cerium, 1 to 2.5% manganese and 0.1 to 1.0% nickel. This composition increases the mechanical strength of the alloy at temperatures of up to 250°C. (TCO)

Radiation Effects

680   AERE-R-3019
United Kingdom Atomic Energy Authority. Research
  Group. Atomic Energy Research Establishment,
  Harwell, Berks, England.
THE THERMAL CONDUCTIVITY OF IRRADIATED AND UNIRRADIATED BERYLLIA. R. C. McGill and J. A. G. Smith. July 1959. 8p. BIS.

Measurements have been made of the thermal conductivity of two bars of hot pressed high density beryllia, one bar having been irradiated in DIDO and the other not irradiated. Differences found were less than those reported by other workers. (auth)

681   ANL-5406
Argonne National Lab., Lemont, Ill.
EFFECTS OF HIGH BURNUP AT ELEVATED TEMPERATURES ON URANIUM-0.52 AND 1.62 w/o ZIRCONIUM ALLOYS. Final Report of Metallurgy Program 6.1.16. J. H. Kittel and S. H. Paine. Aug. 1959. 33p. Contract W-31-109-eng-38. OTS.

An investigation of the effects of irradiation on uranium containing 0.52 and 1.62 wt. % zirconium was made. Specimens of wrought material, variously heat treated, were studied as well as castings of the alloys. It was found that, although the wrought and heat-treated alloys were reportedly stable under thermal cycling, they elongated rapidly under irradiation. The best material studied was the 1.62% alloy in the as-cast condition. It was found to increase in length initially at a rate of about 5% per at. % burnup, after which the rate steadily diminished. Up to burnups of at least 5.3 at. % it retained a smooth surface. Two specimens of the cast 1.62% alloy, one irradiated to 2.1 at. % burnup at a calculated central temperature of 690°C and the other irradiated to 5.3 at. % burnup at a calculated central temperature of 620°C, swelled and increased in volume with the formation of a large central void surrounded by highly porous metal. The critical swelling temperature of uranium-1.62 wt. % zirconium alloy was found to lie between 300 and 620°C, with some indications that it may be near 500°C. (auth)

682   IGR-49(RD/C)
United Kingdom Atomic Energy Authority. Industrial
  Group. Culcheth Labs., Culcheth, Lancs., England.
THE IRRADIATION BEHAVIOR OF ALPHA-URANIUM SINGLE CRYSTALS. C. Tyzack. Feb. 17, 1959. 19p. BIS.

Single crystals of alpha-uranium have shown that the principal slip system changes from (010) [100] at room temperature to (001) [100] at 600°C. This suggests a change in the balance of the lattice binding forces with increasing temperature, which could be effected by a change in the unit cell parameter v from 0.105 toward 0.167. The effect of this is to change the interstitial position of minimum potential energy in the unit cell from a pyramidal site to an octahedral site. It is suggested that this is the basic reason for the diminution and eventual reversal of growth in the [010] direction with increasing temperature, which is observed during the irradiation of [010] textured wires of alpha-uranium. (auth)

683   KAPL-M-DGM-3
Knolls Atomic Power Lab., Schenectady, N. Y.
THE NONDESTRUCTIVE DETERMINATION OF U-235 DISTRIBUTION AND TOTAL U-235 LOAD IN URANIUM-ZIRCALOY-2 ALLOY TYPE IRRADIATION SPECIMENS. D. G. Miller. Sept. 10, 1959. 15p. Contract W-31-109-Eng-52. OTS.

The D1G Type 1 specimens consisted of a U-Zircaloy-2 fuel clad in a Zircaloy-2 jacket. The total U^{235} load in the specimens was determined by the gamma scanning technique with a precision of at least ±1% at the 95% confidence limits. The homogeneity of the specimens was determined with a precision of about ±3.5% for 8 wt. % U (93.2% enriched) fuel and about ±5% for 4 wt. % U fuel. (W.D.M.)

684   NAA-SR-Memo-4135
EXAMINATION OF SAMPLES FROM URANIUM BAR, NRX No. 683. J. Bloch, J. P. Mustelier, D. Tardivon, P. Bussy, and J. Blin. Translated by R. Moeller and B. Moeller from note CEA-271, 1958. 20p. JCL or LC.

The examination of three pieces of irradiated U from a fuel element NRX-683 is presented. The microhardness, swelling after annealing, and density data are reported for the irradiated U. (W.L.H.)

685

ELECTRON SPIN RESONANCE AND THERMOLUMINESCENCE IN IRRADIATED FUSED QUARTZ.
Per Olof Fröman, Rune Pettersson, and Tore Vänngård (Univ. of Uppsala). Arkiv Fysik 15, 559-66(1959).

Fused quartz was irradiated with neutrons and protons at room temperature and with x rays and γ rays at liquid air temperature. The two corpuscular radiations give rise to a narrow electron spin resonance line superimposed on a broader six-line structure, which is tentatively suggested to be due to a hyperfine interaction with impurities of Al^{27}. The samples exposed to the electromagnetic radiations at liquid air temperature show in addition an unstable resonance line, and on heating they emit light. It is found that the electron spin resonance and the thermoluminescence are due to different kinds of centers. (auth)

686

ELECTRON DAMAGE THRESHOLDS IN InSb. F. H. Eisen and P. W. Bickel (Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.). Phys. Rev. 115, 345-8(1959) July 15.

Measurements of carrier removal rate and isochronal recovery in electron-irradiated InSb indicate that displacements are produced at electron energies as low as 240 kev. Two recovery stages were found and the activation energies for recovery determined. The conduc-

tivity recovery in the low-temperature stage was found
to be first order. (auth)

687

TEMPERATURE-DEPENDENT DEFECT PRODUCTION
IN BOMBARDMENT OF SEMICONDUCTORS. G. K.
Wertheim (Bell Telephone Labs., Murray Hill, N. J.).
Phys. Rev. 115, 568-9(1959) Aug. 1.

A model is proposed to explain the observed depend-
ence of the defect production rate on temperature when
semiconductors are bombarded with electrons of suf-
ficient energy to produce vacancy-interstitial pairs.
The decreased defect density observed after low-
temperature bombardment may be due to the produc-
tion of a metastable vacancy-interstitial pair which may
either anneal or form the defect usually observed. A
temperature dependence in the production rate arises
if these two competing processes have different acti-
vation energies. (auth)

688

INVESTIGATION OF THE CONDUCTIVITY INDUCED IN
THIN FILMS OF ALUMINIUM OXIDE BY ELECTRON
BOMBARDMENT. N. L. Yasnopol'skii, A. P.
Alekseyeva, and T. I. Kofanova. Radiotekh. i Elektron.
4, 857-65(1959).

The measurements were carried out by means of an
experimental tube. The experimental setup is described
and results are discussed. From the experiments it is
concluded that, when a dielectric film having a thick-
ness of 0.1 to 0.3μ is bombarded by an electron beam
having an energy of about 5 to 7 kev, it is possible to
obtain an induced conductivity coefficient of the order of
40 to 50. (W.D.M.)

689

DISPLACEMENT OF ATOMS IN A SOLID BY THE
ACTION OF γ-RAYS. V. V. Galavanov (Leningrad
Physico-Technical Inst.). Soviet Phys.—Solid State 1,
390-9(1959) Mar.

The possible mechanisms of the formation of Frenkel
type defects (atom in interstitial position—vacant site)
in crystals by the action of γ rays having an energy of
about 1 Mev are discussed. The cross section of defect
formation is determined for elastic scattering of the
γ rays at the nucleus, $\sigma_{scatt.}$, for the photoelectric effect,
$\sigma_{rec.}$, and for elastic scattering of fast photoelectrons,
$\sigma_{phot.}$, and Compton electrons, $\sigma_{Comp.}$ at the nucleus.
The effects $\sigma_{phot.}$ and $\sigma_{Comp.}$ are determined for a thick
crystal (l ≫ R, where l is the thickness of the crystal
and R is the mean path of an electron in the crystal). A
method of graphical integration enables the spectrum of
the energy distribution of Compton electrons to be taken
into account. For germanium, given an energy of the
γ-quantum of 1.25 Mev, the cross sections of formation
of Frenkel defects are equal respectively, to: $\sigma_{scatt.} \simeq
2.10^{-29}$ cm^2, $\sigma_{rec.} \simeq 1.10^{-27}$ cm^2, $\sigma_{phot.} \simeq 1.10^{-26}$ cm^2,
and $\sigma_{Comp.} \simeq 2.10^{-25}$ cm^2. (auth)

PHYSICS

General and Miscellaneous

690   AAEC/E-36
Australia. Atomic Energy Commission Research
   Establishment, Lucas Heights, New South Wales.
ENERGY AND LETHARGY DISTRIBUTION OF NEU-
TRONS SLOWING DOWN IN GRAPHITE. K. C. Hines.
Mar. 1959. 16p.

For neutrons slowing down in an infinite homogeneous
moderator consisting of a single element, the energy
dependent flux of neutrons satisfies a simple integral
equation when the sources of fast fission neutrons are
uniformly distributed in space. This equation is readily
soluble for neutrons slowing down in hydrogen and in
heavier moderators for the energy range $\alpha E_0 \leq E \leq E_0$
(where αE_0 is the lowest energy that a neutron of initial
energy E_0 can have after a single collision in the moder-
ator). For $E < \alpha E_0$, however, an analytical solution of
the integral equation is not possible for moderators
heavier than hydrogen. It is shown how a solution for
lower energies may be obtained using a step-by-step
procedure based on the simple solution of the problem
for energies close to the initial energy. The method
lends itself to programming for a digital computer and,
for graphite, numerical results were obtained using the
IBM 650. The results take no account of absorption in
the graphite during slowing down or of inelastic scat-
tering by nuclei of the moderator and it is assumed
that, for all energies, scattering is spherically sym-
metric in the center of mass system. (auth)

691   ACR-31
Office of Naval Research, Washington, D. C.
CONFERENCE ON RADIO AND MICROWAVE SPEC-
TROSCOPY HELD AT DUKE UNIVERSITY, NOVEM-
BER 4, 5, 6, 1957. 98p.

Digests are given for 19 papers presented at a con-
ference on radio and microwave spectroscopy. Items
covered include nuclear magnetic resonance, paramag-
netic resonance, ferromagnetic resonance, radio-
frequency spectroscopy, etc. Purpose of the conference
was to bring together a representative group of people
from different branches of the general field in order to
inform one another of the most significant developments
in the various specialties and to further the exchange
of ideas and techniques between these specialties.
(W.D.M.)

692   AECU-4373
Martin Co. Nuclear Div., Baltimore.
POWER FROM RADIOISOTOPES. K. P. Johnson.
[1958]. 18p. OTS.

The relative power producing capabilities of several
isotopes are considered and their present costs and
availability are discussed. Their use for power produc-
tion in the near future should be considered only for
special applications where an extremely dependable
source of heat coupled with a simple power conversion
system is required. (W.D.M.)

693   AERE-R-3061
United Kingdom Atomic Energy Authority. Research
   Group. Atomic Energy Research Establishment,
   Harwell, Berks, England.
THE VALIDITY OF THE CONSTANT ACTIVATION EN-
ERGY MODEL FOR THE RELEASE OF STORED EN-
ERGY IN GRAPHITE. D. E. Rimmer. Aug. 1959. 13p.
BIS.

The constant activation energy model for the release
of stored energy in graphite was found to be sufficiently
accurate to be used for the prediction of annealing be-
havior under any conditions relevant to the annealing in
the BEPO moderator. (auth)

694   AFCRC-TN-59-892
Stanford Univ., Calif. Microwave Lab.
ACTION-TRANSFER AND FREQUENCY-SHIFT RELA-
TIONS IN THE NONLINEAR THEORY OF WAVES AND
OSCILLATIONS. P. A. Sturrock. Sept. 1959. 21p.

Project No. 47501. Contract AF49(638)-415. (ML-625).

Certain relations which have arisen in the theories of electrical networks, electron tubes, plasma oscillations, and particle accelerators are shown to be special cases of general relations attributable to any system which may be described by a Hamiltonian. If such a system is analyzed into an interacting set of modes (waves or oscillators), it is found that the rates of transfer of action to or from members of a group of interacting modes are in integral ratios, the integers being determined by the interaction, and are related in magnitude to the energy associated with the interaction. It is found furthermore a conjugate set of relations which lead to the following statement: the fractional shifts in frequency of members of a group of interacting modes, when multiplied by the energies in those modes, are in integral ratios, the integers being determined by the interaction, and are related in magnitude to the energy associated with the interaction. The "action-transfer relations" allow one to draw a close parallel between the nonlinear theory of propagating media and the quantum or classical theories of particle collisions. These relations are closely related to the Poincaré and adiabatic invariants. The "frequency-shift relations" provide useful information relating the frequencies of uncoupled modes and the frequencies of excitation of these modes to the partition of energy of this excitation among these modes. This application is demonstrated by a simple example. (auth)

695   AFSWC-TR-58-35
Cornell Aeronautical Lab., Inc., Buffalo.
RADIATIVE PROPERTIES OF HIGH TEMPERATURE AIR; FINAL REPORT. Walter H. Wurster, Herbert S. Glick, and Charles E. Treanor. Sept. 1959. 78p. Project No. 5776-57877. AF29(601)-176. OTS.

The spectral properties of high-temperature air were studied in both absorption and emission. The experimental apparatus and the data obtained in the experiments are discussed in detail. Results are presented which show that molecular oxygen plays a dominant role in the ultraviolet absorptive characteristics of air. The measured absorption coefficients in air are given as functions of wavelength. The average transmission over 50A intervals is tabulated for various conditions of density and temperature, and the results correlated on the basis of the oxygen content of the heated air. Approximate f values are given for the O_2 vibrational bands in the spectral region 2600 to 2850A. Based on these values, calculations of the averaged absorption of O_2 at lower densities are presented. (auth)

696   CEA-914
France. Commissariat à l'Énergie Atomique, Paris.
PRÉPARATION ET PROPRIÉTÉS DES FILMS MINCES UTILISÉS DANS LES DÉTERMINATIONS D'ACTIVITÉ AU COMPTEUR 4 π. (Preparation and Properties of Thin Films Used in Activity Determinations with a 4 π Counter.) M. Jannez, Y. Le Gallic, and M. Thenard. Oct. 1958. 11p.

A comparative study was made of various methods of preparing thin films, for use as source holders in the 4 π counter, and of measuring their thickness. The following properties were investigated: mechanical resistance, heat resistance, aging, and resistance of rhodopas, polystyrene, formvar, and cellulose acetate films to the action of various chemical agents. (auth)

697   CU-189
Columbia Univ. New York.
SLOW NEUTRON RESONANCES IN Ag, Ta, AND Cd

(thesis). Scott Desjardins. May 26, 1959. 113p. Contract AT-30-1-Gen-72. OTS.

Slow neutron resonances in Ag, Ta, and Cd were examined using the Columbia University Nevis Velocity Selector with a 2000 channel time-of-flight data storage system. Neutron widths were calculated for 149 levels and radiation widths for 24 levels. Values of the s-wave strength functions obtained were Ag, $(0.53 \pm 0.1) \times 10^{-4}$; Ta, $(1.9 \pm 0.3) \times 10^{-4}$; and Cd (odd isotopes), $0.38 \pm 0.14) \times 10^{-4}$. In Ag, 16 new spin assignments are made above 100 ev which are felt to be reliable, bringing the total number of spin assignments for Ag to 25. Of these 25, 20 are J = 1 and 5 are J = 0. Upon comparing $g\Gamma_n^0$ for the spin assigned levels to $g\overline{\Gamma}_n^0$ for the part of the data that is felt to form an almost complete sequence of levels, it is shown that the data are at least consistent with the hypothesis that Γ_n^0 is independent of spin and that the level spacing per spin state is proportional to $(2J + 1)^{-1}$. The data are harder to reconcile with the assumption that $\overline{\Gamma}_{nJ}^0 / \overline{D}_J$ is independent of spin. No definite conclusion can be drawn concerning the spin dependence of the average reduced width and the average level spacing. In Ag, a number of very narrow resonances ($\Gamma_n^0 \sim 0.02$ mv) cause a marked departure for the total distribution of reduced widths from a Porter-Thomas distribution. The assumption that the narrowest resonances are due to p-wave neutrons is found to improve the fit of the remaining reduced widths to a Porter-Thomas distribution and to imply a tentative value for the p-wave strength function in Ag of $(2.8 \pm 1.2) \times 10^{-4}$. (auth)

698   HW-59574
General Electric Co. Hanford Atomic Products Operation, Richland, Wash
A METHOD OF DETERMINING THE THERMAL CONDUCTIVITY OF INCANDESCENT SOLIDS. B. B. Brenden and H W. Newkirk. Mar. 9, 1959. 41p. Contract W-31-109-Eng-52. OTS.

A method is described for determining the thermal conductivity of solids at temperatures above 1000°C in which the sample can be either a conductor or a nonconductor of electricity. The method involves three-dimensional heat flow in a cylindrical rod of finite length which is subjected to a constant heat flux at one end. The boundary conditions allow heat to flow into one end of the sample by conduction and to flow out of the sample by radiation from the other end and sides. These boundary conditions are satisfied in practice by supporting the sample with one end contacting a hot tungsten filament. Heat loss by conduction and convection is minimized by heating the sample in an evacuated chamber. The heat transfer in the rod is represented by the equation

$$\frac{K}{\epsilon} = \frac{\sigma l^2}{24a} \times \frac{U_1^4 + U_3^4 + 10\ U_2^4}{U_1 + U_3 - 2\ U_2} - \frac{\sigma a}{4} \times \frac{U_1^4 + U_3^4 - 2\ U_2^4}{U_1 + U_3 - 2\ U_2}$$

where K is the thermal conductivity in watts cm^{-2} per °K cm^{-1}, ϵ the total emissivity, σ the Stefan-Boltzman constant 5.67×10^{-12} watts cm^{-2} deg^{-4}, l the length of the rod in centimeters, a the radius of the rod in centimeters and U_1, U_2, U_3, the bottom, middle, and top surface true temperatures in degrees Kelvin. The method was tested by making the necessary measurements on samples of graphite and uranium dioxide in the range 1000 to 2000°K. The results show that the method yields useful values of thermal conductivity which, in the worst case, are within a factor of five of published values obtained from similar samples by

another method. Findings suggest that the method yields values which represent the thermal conductivity at the surface of the sample. Alternate solutions are considered for the heat transfer in the rod. An analysis is given leading to a solution for thermal conductivity in rectangular co-ordinates. (auth)

699 ISC-1141
Ames Lab., Ames, Iowa.
ION FRAGMENTATION PATTERNS OF N_2^{28}, N_2^{29} AND N_2^{30}. Gerald D. Flesch and Harry J. Svec. [Mar. 5, 1959]. 5p. Contract [W-7405-eng-82]. OTS.

The ion fragmentation pattern of each of the gases was determined by magnetic scattering at electron acceleration voltages starting with 100 v and reduced at 5 v intervals to the appearance potential of N_2^+. From the patterns of N_2^{28} and N_2^{30}, corrections were determined for the observed pattern of N_2^{29}. Preparation of the three gases is discussed. (W.D.M.)

700 JEN-60
Spain. Junta de Energia Nuclear, Madrid.
BLANCO FINO DE DEUTERIO. (Fine Target of Deuterium). Jacobo Diaz Diaz, Carlos E. Granados Gonzalez, and R. Gutierrez Bernal. 1959. 10p.

A thin deuterium target can be obtained on tantalum foils by the absorption method. In order to obtain the degasification temperature, a high-frequency induction generator is used, and the deuterium inlet is controlled by a palladium valve. The vacuum measurements are available, one for high vacuum measurement in the degasification of the tantalum foils and the other for low vacuum to measure the deuterium inlet into the installation and the variation of the deuterium pressure after absorption in the tantalum foil. A target with a thickness of 48 μ gr/cm^2 is obtained. (tr-auth)

701 JPL-20-106
California Inst. of Tech., Pasadena. Jet Propulsion Lab.
THERMODYNAMIC PROPERTIES AND CALCULATED ROCKET PERFORMANCE OF HYDROGEN TO 20,000°K. David Altman. Sept. 3, 1956. 33p. Contract DA-04-495-Ord-18. (AD-159886).

A tabulation is made of the equilibrium thermodynamic properties of hydrogen between 300 and 20,000°K. Consideration is given to molecular dissociation, atomic excitation, and ionization. The data are presented in Mollier charts, for the purpose of simplifying rocket performance calculations. Tables are presented which list the specific-impulse and power values required to develop a given thrust at a specified chamber temperature. A tabulation is also given of the loading factors required for escape from the earth by a hydrogen missile operating at various temperatures. (auth)

702 KAPL-M-JDL-2
Knolls Atomic Power Lab., Schenectady, N. Y.
A SURVEY AND PRELIMINARY ANALYSIS OF THE PROBLEM OF COLLAPSE OF FUEL PLATES. J. D. Lubahn and W. D. Fowler. Aug. 25, 1959. 58p. Contract W-31-109-Eng-52. OTS.

The fluid and solid mechanics of the fuel plate collapse problem were examined using a simplified, preliminary analysis. The analysis may not be accurate enough to be applicable to currently proposed designs, but it does serve the following purposes: (1) It shows that the physical concepts which are now known, together with a sufficiently accurate analysis, are capable of handling the engineering problems of plate collapse; (2) it serves to point out the principal short-

comings of current analytical methods and outlines additional work needed to overcome the most important of these shortcomings; and (3) it forms a basis for subsequent analytical work which would result in sufficiently accurate results for engineering purposes. In short, the feasibility of a general method of approach to the problem has been demonstrated, and recommendations on how to implement this approach have been made. (auth)

703 KAPL-M-LD-4
Knolls Atomic Power Lab., Schenectady, N. Y.
PRESSURE AND THERMAL STRESSES AT A PIPE ATTACHMENT TO A SPHERE. L. Deagle. Sept. 21, 1959. 37p. Contract W-31-109-Eng-52. OTS.

Design charts and equations were prepared for determining the bending stresses and hoop stresses at the junction of a cylinder and sphere when loaded by: internal pressure; and a difference in average temperature between the cylinder and the sphere. Correlation of calculated stresses and photoelastically determined stresses for models with internal pressure is presented. (auth)

704 KAPL-M-MH-2
Knolls Atomic Power Lab., Schenectady, N. Y.
SOME ASYMPTOTIC RESULTS FOR A COVERAGE PROBLEM. Max Halperin. Sept. 11, 1959. 23p. Contract W-31-109-Eng-52. OTS.

A quantity of considerable interest in calculation of microscopic behavior of heterogeneous materials is the intercept fraction of the phases of the mixture (i.e., the fraction of a particular phase intercepted by a linear path). The statistical behavior of the intercept fraction is studied, for a path of fixed length, under the following idealization: linear sections of a phase are selected at random and placed on a very long line at random, without overlap; and the given path length is placed at random on the long line. Under these assumptions, the distribution of the intercept fraction is derived. Unfortunately, it depends intimately on the distribution of the linear sections of the phase. However, various explicit and useful results are obtained, including exact expressions for the probability of a zero intercept fraction and the expected intercept fraction and limiting expressions for the distribution and variance as various parameters of the intercept distribution approach limiting values. (auth)

705 KAPL-M-S3G-RES-69
Knolls Atomic Power Lab., Schenectady, N. Y.
TCI—AN AUXILIARY ONE DIMENSIONAL TRANSIENT CONDUCTION CODE FOR USE WITH THE ART, SPY AND TER REACTOR DESIGN CODES. J. W. Millard. Sept. 8, 1959. 59p. Contract W-31-109-Eng-52. OTS.

An auxiliary code entitled TCI is described which is used in connection with large transient thermal design codes such as ART, SPY, and TER. TCI is coded in FORTRAN interpretive language for the IBM-704 EDPM. The basic problem solved by TCI is that of obtaining the transient temperature distribution in a single axial node of a plate type fuel element given the power, flow, and temperature history of that node from the output of the design code. Once this distribution is known as a function of time, several supplemental calculations are performed to aid the design engineer in verifying the calculational model utilized in the design codes and/or in obtaining other required data. Although the TCI code is primarily designed to work in connection with the tran-

sient design codes, it is useful for any problem where
a one-dimensional temperature-time history of a solid
is desired. (auth)

706   KR-1
Norway. Institutt for Atomenergi, Kjeller.
WAVELENGTH AND INTENSITY MEASUREMENTS IN
THE SPARK EXCITED SPECTRUM OF NEPTUNIUM.
J. Haaland. Aug. 1959. 14p.

The wavelengths of 203 neptunium lines were meas-
ured with a Zeiss Abbe-comparator with an estimated
accuracy of ±0.03 A. The corresponding wave numbers
in vacuo are calculated using essentially the "Tabelle
der Schwingungszahlen" by H. Kayser. Relative inten-
sities of the lines were measured photometrically
taking the spectral sensitivity of the photoplates into
account. All lines are corrected from background. The
spectrograms were obtained with a 21 ft 15,000 lines
per inch JACO grating spectrograph using the "copper
spark" technique. (auth)

707   NAA-SR-3765
Atomics International Div., North American Aviation,
    Inc., Canoga Park, Calif.
MEASUREMENT OF THE SRE AND KEWB PROMPT
NEUTRON LIFETIME USING RANDOM NOISE AND
REACTOR OSCILLATION TECHNIQUES. C. W. Griffin
and J. G. Lundholm, Jr. Oct. 15, 1959. 33p. Contract
AT-11-1-GEN-8. OTS.

The prompt neutron lifetime of the SRE was meas-
ured by both the oscillation and random noise tech-
niques. Measurement by use of the oscillation technique
gave a prompt neutron lifetime of $(5.25 \pm 0.35) \times 10^{-4}$
sec for a calculated β of 7×10^{-3}. The measured noise
response indicated a lifetime of $(5.25 \pm 0.7) \times 10^{-4}$ sec.
Both measured values are in agreement with the calcu-
lated value of 5×10^{-4} sec. Four experiments utilizing
the noise analysis technique were performed to deter-
mine the prompt neutron lifetime of the KEWB. All four
experiments gave results which agreed within 3%. For
an estimated β of 8×10^{-3}, the measured value obtained
was $(7.8 \pm 0.3) \times 10^{-5}$ sec. This is in reasonable agree-
ment with both the energy independent calculated value
of 6.6×10^{-5} sec and the value of 6.2×10^{-5} sec obtained
from the experimental inhour equation. The oscillation
technique has been found to be better suited for lifetime
determinations in reactors where the prompt neutron
break frequency is less than 5 cps. Reactor noise
analysis is more suitable for reactors which have
prompt neutron lifetime break frequencies above 20
cps. (auth)

708   NAVORD-6227
Naval Ordnance Lab., White Oak, Md.
THE MONTE CARLO METHOD: NEUTRON REFLEC-
TION BY WATER. Paul B. Morgan. Jan. 29, 1959.
60p. (AD-220676).

The Monte Carlo Method with applications of interest
to the physicist is discussed. Papers are listed which:
(a) utilize the technique in the solution of physics prob-
lems, and (b) describe methods of increasing the effi-
ciency of the technique. Comments are made on the
general usefulness of the technique, its limitations, and
pitfalls. The treatment is introductory rather than
comprehensive. The Monte Carlo Method is applied to
the problem of estimating the probability of normally
impinging monochromatic neutrons scattering back
from deep circulating pure water. (auth)

709   NP-7962
Buffalo. Univ.
PROGRESS REPORT NO. 7 [FOR] JULY 1, 1959 TO

SEPTEMBER 30, 1959. J. F. Andrew, N. Juul,
J. Okada, H. E. Strauss, and S. Mrozowski. Oct. 13,
1959. 15p. Contract AF33(616)-5186.

Study of the elastic properties and heat conductivity
of carbons and graphites at room and high temperatures
in relation to fabrication and structural variables con-
tinued. Additional measurements of Poisson's ratio
were made. Strain gage techniques were used to deter-
mine differences in values for Young's modulus as ob-
tained from tensile, compressive, and bending tests.
The effect of convection through pores on the measured
value of thermal conductivity of dense graphite rods
was studied. Measurements of heat diffusivity were ex-
tended to higher temperatures (1300°C) by a new tran-
sient method. (For preceding period see NP-7446.)
(T.R.H.)

710   NP-7987
Battelle Memorial Inst. Radiation Effects Information
    Center, Columbus, Ohio.
MONTHLY ACCESSION LIST NO. 28 [ON RADIATION
EFFECTS DATA]. Oct. 15, 1959. 19p. Project No.
2133. Contract AF33(616)-6564.

711   NP-7994
Utah. Univ., Salt Lake City.
X-RAY TECHNIQUE FOR MEASURING DENSITY VS.
DISTANCE RELATIONSHIPS IN DETONATING EXPLO-
SIVES. Technical Report No. LIV. T. K. Collins.
Sept. 30, 1958. 24p. Project No. 357 239. Contract
N7-onr-45107.

Reinforced concrete instrument shelters constructed
to house x-ray detecting recording equipment are de-
scribed. In addition circuitry for use with the x-ray
equipment is described in detail. Descriptions of equip-
ment tests are given, and problems encountered in op-
eration are discussed. Diagrams and photographs are
included. (J.R.D.)

712   NP-8004
Polish Academy of Sciences. Inst. of Nuclear Re-
    search, Warsaw.
THE ANGULAR DISTRIBUTION OF SECONDARY PAR-
TICLES IN HIGH ENERGY NUCLEAR COLLISIONS
WITH HEAVY NUCLEI OF PHOTOGRAPHIC EMUL-
SIONS. Report No. 105/VI. J. Bartke, P. Ciok,
J. Gierula, R. Hołyński, M. Miesowicz, and T. Saniew-
ska. Sept. 1959. 11p.

The angular distributions of secondary particles pro-
duced in collisions of nucleons with heavy nuclei of
photographic emulsions were investigated and the re-
sults are compared with predictions of the hydrody-
namical "tunnel" theory and with those of the two-
centers model. According to the theory of Milekhin the
tunnel contains the nuclear matter taken as a fluid with-
out any structure and the number of nucleons in the
tunnel is used only for describing the length or the
mass of the tunnel. (W.D.M.)

713   NP-8007
Army Signal Research and Development Lab., Fort
    Monmouth, N. J.
EFFECTS OF MIXED NEUTRON-GAMMA PULSES ON
ELECTRONIC COMPONENTS. D. Markow, H. J.
Degenhart, H. M. Murphy, Jr., and R. Sanna. Sept. 30,
1959. 33p.

Previous experiments with electronic components on
a pulsed nuclear reactor (Godiva II) indicated that tran-
sient effects exist that are different from those ob-
served during and after long-term irradiations. An ex-
periment is described which was to determine whether
the effects observed at Godiva II on selected electronic

components would be detectable at the lower radiation dose rates and longer pulse widths from KEWB and TRIGA, as well as at the very low dose rates and short pulse widths from the General Atomics linac. Items tested were resistors, capacitors, and a silicon rectifier. (W.D.M.)

714 ORNL-2766
Oak Ridge National Lab., Tenn.
CROSS SECTIONS FOR THE DISSOCIATION OF H_2^+ AND D_2^+ BY A VACUUM CARBON ARC. R. G. Alsmiller, Jr. Oct. 23, 1959. 20p. Contract W-7405-eng-26. OTS.

The cross section for the dissociation of the H_2^+ and D_2^+ molecule by a particle of charge ze is calculated. The calculation is carried out in Born approximation using exact two-center wave functions, the Frank-Condon principle, and a classical average over molecular orientations. The cross section is compared with the cross section calculated by Ivash using L.C.A.O. wave functions, and it is found that the two cross sections are in good agreement over the entire velocity range considered. The calculated results are compared with experimental results obtained from the dissociation of H_2^+ and D_2^+ by a vacuum carbon arc. The theoretical and experimental results are found to agree within a factor of two. (auth)

715 ORNL-2807
Oak Ridge National Lab., Tenn.
A STUDY OF ALPHA PARTICLE IONIZATION IN ARGON MIXTURES. F. W. Sanders, G. S. Hurst, and T. E. Bortner. Oct. 23, 1959. 59p. Contract W-7405-eng-26. OTS.

The existence of one or more long-lived non-metastable excited states of argon in the 15 to 15.5 ev range has been indicated. The increased ionization observed when certain impurities are added to argon is attributed to this long lived excited state rather than to molecular argon or subexcitation electrons. A competitive process between optical decay and ionizing collisions was evidenced by spectral analysis of the gas mixtures. From these experiments it was not possible to determine the exact energy levels of the suggested long-lived excited states. (auth)

716 PA-TR-2566
Picatinny Arsenal. Feltman Research and Engineering Labs., Dover, N. J.
SURFACE PHENOMENA IN SOLIDS. A Literature Review. Cecil G. C. White and Samuel Helf. May 1959. 34p. DA Project 599-04-001. (AD-208231).

The results of a literature survey on some of the fundamental principles and experimental practices involved in the study of adsorption phenomena on solids are described. One section consists of an elementary review of the theories of adsorption on solids and another is a description and discussion of the classical methods for the determination of surface area of solids. A third section is devoted to a special bibliography on previous applications of radioactive isotopes to the study of surface phenomena. (auth)

717 SC-4363(TR)
Sandia Corp., Albuquerque, N. Mex.
RADIAL EIGENFUNCTIONS, PHASE SHIFTS, TOTAL ELASTIC, DIFFERENTIAL ELASTIC, AND MOMENTUM TRANSFER CROSS SECTIONS FOR ELECTRONS SCATTERED FROM OXYGEN AND NITROGEN ATOMS. W. J. Byatt, F. O. Lane, Jr., and L. D. Watkins. Oct. 1959. 44p. OTS.

Results of calculations concerning quantities radial eigenfunctions, phase shifts, total elastic, differential elastic, and momentum transfer cross sections for electrons scattered from O and N atoms are presented in a range of incident electron energies $0 \leq V \leq 625$. Relatively accurate eigenfunctions can also, by interpolation, be constructed for energies other than those considered. (auth)

718 SCTM-108-53(51)
Sandia Corp., Albuquerque, N. Mex.
POWER REQUIREMENTS FOR SUSTAINING VIBRATIONS. D. Maxwell Ellett. July 27, 1953. Changed from OFFICIAL USE ONLY Apr. 12, 1959. 13p. OTS.

The power requirements for sustaining steady-state vibrations have been suggested as a useful parameter for describing environmental tests. The equations necessary for this are developed and graphs are drawn which illustrate the amplitudes and force requirements for constant power input and the power requirements for a constant force input. (auth)

719 UCRL-1052
California. Univ., Berkeley. Radiation Lab.
THERMAL CONDUCTIVITY OF METAL INTERFACES. R. A. Heckman. Nov. 30, 1950. Decl. Oct. 14, 1959. 14p. Contract W-7405-eng-48. OTS.

The coefficients of thermal conductivity of aluminum-bismuth metal-to-metal bonds and of aluminum and bismuth surfaces in contact under pressure were measured. The coefficient of thermal conductivity of the metal-to-metal bond was at least 30,000 Btu/hr ft^2 ·F, i.e., thermal resistance was negligible, and the coefficient for the metal surfaces in contact was found to be 2000 Btu/hr ft^2 ·F. (auth)

720 UCRL-5568
California. Univ., Livermore. Lawrence Radiation Lab.
THE SCATTERING OF NEUTRONS FROM POLYCRYSTALLINE MATERIALS. Walter Marshall and Richard N. Stuart. Apr. 8, 1959. 30p. Contract W-7405-eng-48. OTS.

At high incident energies ($\gg 1.0$ ev) neutrons are scattered by individual atoms and the collisions are elastic in the center-of-mass system and quite unaffected by the crystal binding energy. But at lower energies the effects of crystal binding become important; these effects are appreciable at incident energies of 1.0 ev and extremely important at energies ≈ 0.1 ev and lower. Fundamental formulas and a formula for the correction term to the incoherent approximation are derived. Errors introduced by use of the incoherent approximation and the use of the Debye approximation are discussed. Results on total cross sections are described. (W.D.M.)

721 UCRL-5619
California. Univ., Livermore. Lawrence Radiation Lab.
THE PROBLEM OF MEASURING THE ABSOLUTE YIELD OF 14-Mev NEUTRONS BY MEANS OF AN ALPHA COUNTER. J. Benveniste, A. C. Mitchell, C. D. Schrader, and J. H. Zenger. June 23, 1959. 23p. Contract W-7405-eng-48. OTS.

The assumptions used to derive the total neutron yield per detected alpha particle (from the D-T reaction) which were derived in an earlier report are re-examined in the light of additional experimental information. It is concluded that, for an alpha counter at 90°

to the incident beam direction, the assumptions introduce practically no difficulties. Therefore, for precise monitoring in the absence of certain target information, it is recommended that this configuration be used. For counters at angles different from 90°, nonuniformity of target loading contributes the most serious error to the computed yield. (auth)

722   UCRL-8617
California. Univ., Berkeley. Lawrence Radiation Lab.
MEASUREMENT OF AVERAGE NEUTRON ENERGIES FOR (α,n) NEUTRON SOURCES. Wilmot N. Hess and Alan R. Smith. Apr. 1, 1959. 17p. Contract W-7405-eng-48. OTS.

A method is presented for measuring the average energy of the neutrons from a source. The attenuation of the neutrons by polyethylene is measured by the use of a long counter in good geometry. The attenuation length is a sensitive function of the neutron energy. The average neutron energies from several (α,n) sources were measured and agree well with values obtained by other techniques. (auth)

723   WADC-TR-57-226
Vitro Labs., West Orange, N. J.
MEASUREMENT OF THERMAL DIFFUSIVITY OF VARIOUS MATERIALS BY MEANS OF THE HIGH INTENSITY ELECTRIC ARC TECHNIQUE. [Period covered] April 1956 to March 1957. Charles Sheer, Lawrence H. Mead, Donald L. Rothacker, Leonard H. Johnson. May 7, 1957. 61p. Project title: MATERIALS ANALYSIS AND EVALUATION TECHNIQUES. Task title: THERMAL MEASUREMENTS. Contract AF33(616)-3669. (AD-142093).

Studies were made on the tail flame of a high-intensity electric arc to determine its suitability as a medium for testing materials under sustained high-temperature gaseous flow. An electrode geometry for stable operation was established. Measurements are reported on the temperature and velocity distribution in the tail flame at various pressures. Observations on the electrodynamic, magnetic, and thermodynamic properties of the tail flame were made. Surface heat flux rates were measured at 1.0 and 0.1 atmospheres on copper bodies in thermal equilibrium. Diffusivity measurements were made in the tail flame on OFHC copper and graphite plates. (W.D.M.)

724   WAPD-T-783
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
FAST NEUTRON PENETRATION THROUGH REACTOR SHIELDS. N. Hartmann and G. R. Hopkins. June 1959. 27p. OTS.

Measurements of the penetration of reactor fast neutrons as a function of energy have been made in a thermal shield mock-up. The investigation was restricted to neutrons in the 2 to 10 Mev energy region. A neutron energy spectrometer employing a $Li^6I(Eu)$ scintillation crystal was used. Relative spectral distributions are presented for distances up to 12 inches from the core face; the results beyond this point are unreliable due to the effects of the gamma ray background. The spectra obtained are shown to be in good qualitative agreement with the results of the few studies available for comparison. (auth)

725   AEC-tr-3853
A MODEL-INDEPENDENT DESCRIPTION OF THE EFFECTS OF MODULATION IN NUCLEAR INDUCTION. K. Halbach. Translated for Argonne National Lab. from Helv. Phys. Acta 29, 37-46(1956). 8p. JCL.

A relation is derived, independent of the model as well as of the modulation process, for the discussion of modulation effects. In the case of small-amplitude sinusoidal modulation this relation yields a very simple expression for the signal forms, as modified by the modulation effects. Another model-independent representation of the nuclear induction signals is derived for high modulation frequencies, taking saturation effects into account. This representation is of special importance for the experimental techniques of high-resolution nuclear induction spectroscopy. (auth)

726   AEC-tr-3856
EFFECT OF TEMPERATURE ON THE ABSORPTION SPECTRA OF ELECTROLYTIC SOLUTIONS. S. V. Gorbachev and P. A. Zagorets. Translated by A. L. Monks (Oak Ridge National Lab.) from Zhur. Fiz. Khim. 29, 1549-54(1955). 8p. JCL or LC.

The effect of temperature on the absorption spectra in the UV region of Ag^+, Tl^+, Cu^{+2}, Hg^{+2}, Fe^{+3}, Γ, and CrO_4^{-2} ions was investigated. The absorption bands of ions toward longer wave regions with temperature increase were established. The absorption band of CrO_4^{-2} is an exception. Quantitative data were obtained which characterize the displacement, and thermo-displacement coefficients for hydrated ion absorption bands were calculated. (J.R.D.)

727   AEC-tr-3863
ON THE PROBLEM OF DETERMINATION OF DIFFUSION COEFFICIENT IN THE PLASTIC DEFORMATION OF SOLID. Yu. P. Romashkin. Translated by Lydia Venters (Argonne National Lab.) from Fiz. Metal i Metalloved. Akad. Nauk S.S.S.R., Ural.' Filial 7, 825-31 (1959). 12p. JCL or LC.

Equations are given for the determination of diffusion coefficient in the plastic deformation of a solid for the linear case. (W.L.H.)

728   CEA-tr-A-601
UNE REMARQUE SUR LA QUESTION DE L'APPLICATION DES COORDONNÉES DE LAGRANGE DANS LA PHYSIQUE DES OSCILLATIONS NON-LINÉAIRES. (A Remark on the Question of the Application of Lagrange Coordinates in the Physics of Non-Linear Oscillations). H. Muller. Translated from Experientia 14, 166-7

The flowing movement of a fluid medium can be described by certain coordinates which, by their time dependence, characterize the path of all elements of the material qualified by certain parameters. This method, the Lagrange method, is studied in a special example taken from the region of the mechanics of continua, the physics of non-linear oscillations. (T.R.H.)

729
CONSIDERATION ON COHERENT BREMSSTRAHLUNG. O. R. Frisch (Cavendish Lab., Cambridge, Eng.). Acta Phys. Austriaca 12, 331-5(1959). (In German)

Coherent bremsstrahlung, produced by electron scattering on crystal nuclei, is interpreted on purely physical considerations. The effects of the finite aperture of the x-ray beam, nuclear orientation, thermal agitation, and polarization are discussed. (J.S.R.)

730
THERMOLUMINESCENCE OF RARE EARTHS IN CaF_2. Hans Adler (Akademie der Wissenschaften, Vienna). Acta Phys. Austriaca 12, 356-99(1959). (In German)

Investigations on the thermoluminescence of synthetic calcium fluoride phosphors, activated with rare earths or manganese, are described. The results of

the investigation show that the shape of the glow curve is specific for the activator, recombination positions for defect crystals must be determined from the mother crystal, and probably only the numerical distribution of recombinations is influenced by the activator. On the basis of the known data on the defects in the CaF_2 lattice, a clarification for the occurrence of the first-unspecific, bimolecular—glow maximum was investigated. From the study of the curve and from data on radioluminescence and its temperature dependence, it was shown that one and the same activator can emit, according to the configuration of its surroundings, varying bands. The known color changes in the mixed activated natural fluorites go back not only to the differences in the characteristic glow curves, but also various luminous complexes of one activator exist among each other with varying temperature sites of thermoluminescence. Terbium can occur in the four-valent state in CaF_2. (tr-auth)

731

FOCUSING OF ELECTRON BEAMS OF LOW VOLTAGE AND HIGH CURRENT INTENSITY WITH THE HELP OF AN ELECTRIC FIELD IN HELIUM. Adolf Franz (Technische Hochschule, Graz). Acta Phys. Austriaca 12, 412-26(1959). (In German)

The focusing of low voltage, high current intensity electron beams in a helium atmosphere was treated with the utilization of an electric field. The distance of the standing wave from the anode was investigated as a function of the field voltage experimentally and theoretically. (tr-auth)

732

DELBRÜCK SCATTERING IN HOMOGENEOUS MAGNETIC FIELDS. L. Hanke (Universität, Graz). Acta Phys. Austriaca 12, 472-4(1959). (In German)

The scattering of a photon in an infinite expanding homogeneous magnetic field is investigated. The Green Function, obtained earlier (Acta Phys. Austriaca 12, 304(1959)) was used. It is shown that in the case of a homogeneous field in the first approximation no scattering effect occurs. (tr-auth)

733

THEORY OF ION BEAMS IN ELECTROSTATIC FIELDS WITH CONSIDERATION OF SPACE CHARGE. N. Pucker (Universität, Graz). Acta Phys. Austriaca 12, 475-91 (1959). (In German)

A first order perturbation calculation was applied to the paraxial beam through an axially symmetric electrostatic lens and with its help the influence of space charge was determined. The unperturbed orbits were calculated according to a matrix method, which depends on the Gans approximation method, and the perturbations to the trajectory caused by small space charges were investigated. The differential equations for the determination of the perturbation terms were formulated and examined for their solubility. These equations contain in a favorable manner only easily measurable quantities such as electrode voltage, electrode diameter, and position parameters. (tr-auth)

734

SCATTERING OF SLOW NEUTRONS BY MOLECULES OF LIQUID WATER, AMMONIA AND HYDROGEN SULFIDE. A. Wanic (Institute for Nuclear Research, Krakow). Acta Phys. Polon. 18, 255-62(1959).

Theoretical curves for neutron scattering cross-section vs. energy for H_2O, NH_3, and H_2S were compared

with the experimental values for liquid substances. Disagreement obtained at low energy region was interpreted as an evidence of non existence of any free rotation of molecules in investigated liquids. (auth)

735

AN APPROXIMATION OF THE EQUATION OF STATE OF A FERMI-DIRAC GAS. H. A. Buchdahl (Univ. of Tasmania, Hobart). Ann. Physik 3, 345-51(1959). (In German)

From fixed series developments, elementary approximations in closed form were obtained for the equation of state of an ideal Fermi-Dirac gas in an arbitrary degree of degeneracy, without making use of any numerically calculated values. It was required that each permissible approximation in both extreme cases, that is, the almost complete degeneracy or non-degeneracy, represent accurately not only the pressure of the gas but also its specific heat. The results were compared tabularly with known values. (tr-auth)

736

ELECTROPHORESIS IN ARGON—MERCURY LOW PRESSURE DISCHARGE. H. Morgenroth (Deutschen Akademie der Wissenschaften, Berlin). Ann. Physik 3, 373-95(1959). (In German)

In a direct current argon—mercury low pressure discharge, the mercury concentration and the electron temperature depends on the cathode distance. The corresponding relations were formulated and the equations obtained were confirmed by intensity and electron temperature measurements. As an application of the results the electron mobility for various electron temperatures and mercury concentrations was calculated. (tr-auth)

737

SCATTERING FACTORS FOR SOME OF THE HEAVIER ATOMS. Beatrice H. Worsley (Univ. of Toronto). Can. J. Phys. 37, 967-9(1959) Sept.

A program for calculating x-ray atomic scattering factors from the radial wave functions was written for the IBM 650. It was applied to the results of self-consistent field calculations previously performed on the FERUT computer. Results are given for Ne, V^{++}, Kr, Ag^+, and Pb^{+++}. The results for Ne and V^{++} are compared with those calculated by Freeman using Allen's wave functions for Ne and Hartree's approximate wave functions for V^{++}. (auth)

738

THERMAL CONDUCTIVITY OF SOLID ARGON AT 80°K. D. J. Lawrence, A. T. Stewart, and E. W. Guptill (Dalhousie Univ., Halifax, N. S.). Can. J. Phys. 37, 1069-72(1959) Sept.

The thermal conductivity of solid argon at 80°K was determined to be K = 2.6 ± 0.4 mw/cm deg. The technique used is suitable for about 10% accuracy. (C.J.G.)

739

RADIO STAR SCINTILLATIONS AND IONOSPHERIC DISTURBANCES. T. R. Hartz (Defence Research Telecommunications Establishment, Ottawa). Can. J. Phys. 37, 1137-52(1959) Oct.

The generation mechanism for the ionization irregularities in the upper atmosphere which are responsible for radio star scintillations is considered. The general belief that scintillations are related to the spread-F phenomenon observed on ionosonde recordings is found to be an inadequate explanation for the scintillations at 53 Mc/s recorded at Ottawa. An examination of the Ottawa recordings shows that there is a definite association,

both in time of occurrence and geographical location, with those ionospheric disturbances that are usually considered to be due to incoming solar particles. Since other workers at more southerly geomagnetic latitudes have associated their scintillation observations with the spread-F phenomenon which they consider to be independent of auroral activity, it would appear that two mechanisms, at least, are responsible for the radio star fluctuations, the precipitation of solar corpuscles and a mechanism linked with the spread-F phenomenon. The former seems to predominate at high latitudes, the latter is probably predominant at low latitudes, while both mechanisms probably are operative in middle latitudes. (auth)

740

SIMULTANEOUS RECORDING OF THE MAGNETIC EFFECTS PRODUCED BY ARGUS EXPERIMENT IN FRANCE, AT THE EQUATOR, AND IN THE ANTARCTIC. Edouard Selzer. Compt. rend. 249, 1133-5(1959) Sept. 28. (In French)

The Argus experiment, a series of three nuclear explosions at about 480 km altitude over the South Atlantic, produced in each case magnetic signals which the French stations at Chambon-la-Forêt, Bangui, and the Antarctic could record with great clarity and at precise instants. (tr-auth)

741

RADIOLUMINESCENCE FROM BETA RADIATION. G. Parolini (Istituto di Fisica Tecnica, Rome). Energia nucleare (Milan) 6, 571-87(1959) Sept.

A study is described of the emission of light by a fluorescent salt excited by β radiation. The first part outlines the theoretical relations and describes the experimental equipment, the preparation process of samples and methods used for the measurement and the evaluation of results. The second part concerns the results of a comprehensive series of measurements which were carried out in order to determine the luminance of the samples under the action of β radiation as well as the efficiency of the process. Such measurements show the influence of the amount of fluorescent salt per unit area of the sample and the influence of diameter of the granules. The results obtained show satisfactory agreement with the theory. As a conclusion, suggestions are given for further research in order to obtain higher values, both of luminance and efficiency. (auth)

742

DETERMINATION OF THE AVERAGE STOPPING POWER AND ENERGY ABSORBED IN IRRADIATED MEDIUM. G. Joyet (Institut Universitaire de Radiologie, Zurich). Helv. Phys. Acta 32, 261-3(1959). (In French)

The Bragg-Gray relationship for the energy absorbed per unit mass of irradiated tissue is modified to give the ratio of the mean stopping power of different media. If E_i is the incident energy which causes at the depth x the ionization N_a, one has $E_i = (N_{ao}/\mu)W_a(\overline{Sm/Sa})$, where N_{ao} is the ionization extrapolated to the origin, W_a is the energy necessary to form ion pairs in air, and $\overline{Sm}$ and $\overline{Sa}$ are the mean stopping power in the medium and air. For several media exposed to the same spectrum and the same incident energy the relationship $(N_{ao1}/\mu_1)\overline{Sm}_1 = (N_{ao2}/\mu_2)\overline{Sm}_2 = (N_{ao3}/\mu_3)\overline{Sm}_3$. (J.S.R.)

743

DETERMINING THE PROCESS OF AIR IONIZATION FOR Co^{60} GAMMA RADIATION. K. K. Aglintsev, G. P. Ostromukhova, and Ye. A. Khol'nova. Izmeritel'naya Tekh. No. 2, 52(1959).

Tests were made to determine the value of ionization in the air for Co^{60} gamma radiation. Tests with four different Co^{60} preparations showed that the mean value of ionization equaled 33.7 ± 1.5 ev. (TCO)

744

ATOMIC ENERGY LEVELS AND SPECTRA OF NEUTRAL AND SINGLY IONIZED PHOSPHOROUS (P I AND P II). William C. Martin (Princeton Univ., N. J.). J. Opt. Soc. Am. 49, 1071-85(1959) Nov.

The spectrum of a hollow-cathode discharge in a mixture of phosphorus vapor and helium has been photographed and measured from 500 to 10,000 A. This source gave new lines of P II and a much more complete P I spectrum than has hitherto been observed. The P II spectrum of 401 lines is essentially classified by combinations of 38 even and 54 odd levels. Thirty-six of these levels are new, and 29 previously listed levels have been rejected. The $3s^2$ 3p 3d, 4d, 4p, 4f, and 3s3p³ configurations are now complete. Several 5d and 6s levels and most of the expected 5p levels have been found. Except for 3s3p³ and $3s^2$3p·nd, which show interaction, the configurations are in good agreement with first-order Russell-Saunders theory. The P II ionization potential is 19.72 v. The previous analyses of P I have been revised and extended to include 98 even and 43 odd levels classifying 382 of 490 lines. New terms belonging to the configurations $3s^2$3p⁴4−7s, 4−6p, 3−7d and 4,5f have been found. Wherever feasible, the results have been confronted with the predictions of theory. Several series allow the calculation of a new ionization potential, which is 10.484 v. (auth)

745

HYPERFINE STRUCTURE OF THALLIUM²⁰³ AND THALLIUM²⁰⁵ IN THE 7 ²S_½ STATE. R. J. Hull and H. H. Stroke (Massachusetts Inst. of Tech., Cambridge). J. Opt. Soc. Am. 49, 1088-9(1959) Nov.

The hyperfine-structure separations of Tl²⁰³ and Tl²⁰⁵ in the 7²S_½ state were obtained from the 3776-A resonance line with a grating spectrograph. These measurements were carried out because previously quoted values resulted from a study of the 5350-A transition ending on the 6²P_½ state, the hyperfine structure of which was inferred to be 8 mk, while recent atomic-beam magnetic-resonance experiments showed $\Delta\nu(6^2P_½) \approx 17$ mk. The results for $\Delta\nu(7^2S_½)$ are 405 ± 5 mk and 412 ± 4 mk for Tl²⁰³ and Tl²⁰⁵. (auth)

746

VISIBLE AND ULTRAVIOLET ABSORPTION PROPERTIES OF URANIUM DIOXIDE FILMS. R. J. Ackermann, R. J. Thorn, and G. H. Winslow (Argonne National Lab., Lemont, Ill.). J. Opt. Soc. Am. 49, 1107-12(1959) Nov.

Films of uranium dioxide ranging in thickness from 132 to 280 mμ were evaporated onto fused silica, annealed at a pressure of 10^{-6} mm Hg and 960°C, and measured for optical absorption between the wavelengths of 210 and 800 mμ. A moderately intense band observed at 240 to 500 mμ has an unsymmetrical shape with a maximum at about 318 mμ, an approximately linear part with a moderate negative slope between 318 and 380 mμ, and a large negative slope between 380 and

500 mμ. This broad band is undoubtedly at least two unresolved peaks. From 240 mμ to shorter wavelengths there is a very intense absorption band which is most probably the fundamental band for UO_2. The extinction coefficient was found to vary from 0.0055 ± 0.0007 at 650 mμ to a maximum of 0.3702 ± 0.0010 at 360 mμ and to a value of 0.167 ± 0.004 at 240 mμ. The index of refraction varied from 2.29 ± 0.03 at 800 mμ to a maximum of 2.58 ± 0.22 at 450 mμ. The effect of oxidation of the films within the UO_2 phase suggests that the one unresolved band at 430 mμ is removed by oxygen and the one at 300 mμ becomes more intense. (auth)

747

MAGNETIC RESONANCE OF ATOMIC LEVELS EXCITED BY ELECTRONS. J. C. Pébay-Peyroula (Université, Paris). J. phys. radium **20**, 721-9(1959) Aug.-Sept.

Experiments have been described in which magnetic resonances of levels 6 $^3F_4$, $5d^96s^26p^1D_2$, and $^3P_2$ of mercury were produced. Electron bombardment was used for exciting the levels. It is shown that measurements of the width of the even isotope lines lead to the value of the lifetime of the level. Landé factors have also been determined. In the case of the odd isotopes Hg^{199} and Hg^{201}, the Back-Goudsmit effect of the 6 $^3F_4$ level has been studied. An approximate value of the hfs intervals of this level has been obtained. The same technique has given positive results on some levels of the Na atom. (auth)

748

STUDY OF THE CHARACTERISTICS OF A BETA SPECTROGRAPH USING A MAGNETIC FIELD WITH CONSTANT rH. C. Bastard, J. Lafoucriere, and R. Margrita (Université, Lyon). J. phys. radium **20**, 736-41(1959) Aug.-Sept.

A study has been made of the characteristics of a β spectrograph using an inhomogeneous magnetic field of constant rH. The twisted paths of the changed particles are computed with an IBM 650 calculator for the determination of axial aberrations of sphericity. (auth)

749

REFLECTION OF FAST NEUTRONS FROM WATER. Martin J. Berger and John W. Cooper. J. Research Natl. Bur. Standards **63A**, 101-44(1959) Sept.-Oct.

The backscattering of fast (0.3, 1, 3, 6, 9, and 14 Mev) neutrons from a semi-infinite water medium was calculated by the Monte Carlo method. The information obtained includes the joint angular and spectral distribution of the reflected neutrons, the dependence of the number albedo and energy albedo on the source energy and obliquity, and the contributions to the albedo of successive orders of scattering. The spectra were calculated down to epithermal energies (~ 0.5 ev). The results for each case are based on the analysis of 3,000 neutron histories, generated with the use of an IBM-704 computer. In the random sampling, elastic scattering from hydrogen and oxygen, inelastic scattering from oxygen, and absorption due to n-α and n-p processes were taken into account. The cross sections for some of these interactions are not well known. Parallel calculations with different assumptions about the cross sections were made in order to estimate how sensitively the albedo depends on the cross sections. A self-contained description of the Monte Carlo method, its application to the calculation of radiation diffusion and in particular

to the neutron albedo problem are included. Emphasis is placed on the technique of correlated sampling which makes possible an accurate estimate of albedo differences resulting from different assumptions about the cross sections. The random sampling computations were supplemented by analytical calculations of the single-scattering albedo. This was useful for an understanding of the Monte Carlo results because a considerable fraction of the reflected neutrons return after only one collision. (auth)

750

SOME VIBRATIONAL-ROTATIONAL BANDS OF DEUTERATED METHANES. Harry C. Allen, Jr., and Earle K. Plyler. J. Research Natl. Bur. Standards **63A**, 145-52(1959) Sept.-Oct.

A parallel band at 2,200 cm^{-1} and a perpendicular band at 2,780 cm^{-1} of CH_3D were observed under high resolution and analysed. The analysis of the perpendicular band revealed the presence of l-type doubling in the doubly degenerate excited state. From the analysis of the parallel band it is found that $B_0 = 3.880$ cm^{-1}. A hybrid band of CD_3H was observed near 2,600 cm^{-1}. Both active components, A and E are observed and analysed. The ground state B_0 value found from this analysis is in good agreement with previous determinations. (auth)

751

DIELECTRIC MEASUREMENTS ON THIN FILMS BY MEANS OF ELECTRODES COATED WITH IRRADIATED SILICONE RUBBER. W. P. Baker and F. B. Waddington (Metropolitan-Vickers Electric Co. Ltd., Manchester, Eng.). J. Sci. Instr. **36**, 309-12(1959) July.

The difficulties in measuring the dielectric properties of thin films by conventional methods are discussed and an alternative method using electrodes faced with a rubber-like material is described. It is found that irradiated polydimethylsiloxane is the only material which is entirely satisfactory for the coating of the electrodes. (auth)

752

ADHERENCE OF SOLID PARTICLES TO FLAT STICKY SURFACES. J. Rosinski, C. Nagamoto, and A. Ungar (Armour Research Foundation, Chicago). Kolloid-Z **164**, 26-31(1959).

An equation estimating the total number of particles deposited on a flat, sticky surface was derived and checked experimentally. Peel work of a gummed film was defined and its relationship to particle capture examined. The differences in experimental results were explained satisfactorily by means of the rebound phenomenon. The experiments were performed in the absence of electrostatic charge on the collecting sticky surface and on the particles. Under these conditions formation of a single layer of particles collected on the sampling surface was observed. (auth)

753

A PERMANENT MAGNET FOR THE RADIOSPECTROSCOPIC INVESTIGATION OF NUCLEAR MAGNETIC RESONANCE IN METALS AND ALLOYS. O. T. Malyuchkov and V. S. Pavlovskaya. Nauch. Doklady Vysshei Shkoly Met. No. 3, 231-5(1958).

To determine the nuclear magnetic resonance in metals and alloys a permanent magnet for the radiospectrometry was produced. The alloy ANKO-4 (GOST 4402-48) was used as source material for this permanent magnet. The magnet consists of 18 disks with a diameter of 230 mm; it is 50 mm high. The position of the

disks as related to one another with respect to the frame consisting of Armco iron is shown. The magnetic disks cast of this material have high magnetic properties, $B_r = 13100$ gauss, $H_c = 575$ oersted, $B_d = 11000$ gauss, $H_{di} = 450$ oersted, and $(BH)_{max} = 4.9 \times 10^6$ gauss-oersted. With these properties the cast disks meet the requirements for the production of permanent magnets. (TCO)

754

PENETRATION OF GAMMA RADIATION. PRACTICAL EXPERIENCE FROM N-EXPLOSIONS. Nuclear Energy Engr. 13, 509-10(1959) Oct.

The shielding properties of concrete against gamma-ray fallout from two nuclear explosions were studied. Geiger counters were inserted into spaces between the slabs (reinforced concrete $8\frac{1}{2}$ ft. square and 40 in. deep) to measure the dose rate as a function of depth. The dose rate under 2 in. of concrete was found to be $\sim \frac{1}{10}$ that at 9 ft. above ground. Each additional 6 in. of concrete reduces the dose rate by another factor of $\sim \frac{1}{10}$. The over-all attenuation in 22 in. of concrete is therefore about 0.0001 of the dose rate at 9 ft. above ground. The experimentally observed decrease in dose rate with depth shows good agreement with theory for an ideal situation. Results of the work indicate that the time dependence of the dose rate above ground is $t^{-1.2}$ which is in good agreement with other dose-decay measurements. (C.J.G.)

755

VACUUM DEPOSITION OF URANIUM ON THIN OR-GANIC BACKINGS FOR NUCLEAR SPECTROSCOPIC USE. Peter Erman (Nobel Inst. of Physics, Stockholm) and William Parker (Univ. of Uppsala). Nuclear Instr. and Methods 5, 124-6(1959) Aug.

A method was developed for the preparation of uranium converters for use in high resolution gamma spectroscopy. Vacuum deposition was found to be preferable because homogeneous films can be obtained on organic backing materials. The present method enables metallic uranium converters to be produced with a thickness up to 2 mg/cm^2. (auth)

756

PERTURBATION METHODS FOR REACTOR DIFFUSION EQUATIONS. Lowell H. Holway, Jr. (Raytheon Co., West Newton, Mass.). Nuclear Sci. and Eng. 6, 191-201 (1959) Sept.

The multigroup diffusion equations are solved formally by expanding the flux in each group in a series of eigenfunctions of the scalar Helmholtz equation. The resulting secular determinant is complicated, but a perturbation solution may be developed for the coupled multigroup equations. In the case of one energy group, the perturbation method chosen reduces to a formula simpler to use and more rapidly convergent than the Rayleigh-Schroedinger formulas. An operator convenient for expressing the boundary conditions at an interface in multiregion reactors is defined. The foregoing techniques are applied to the Fermi age equation for a reflected reactor. Numerical examples are given to illustrate the rates of convergence in typical reactor design problems. (auth)

757

COMMENTS ON BELL'S APPROXIMATION TO THE RESONANCE INTEGRAL. Charles Kelber and Phillip Kier (Argonne National Lab., Lemont, Ill.). Nuclear Sci. and Eng. 6, 251(1959) Sept.

Bell's approximation for slab lattices is compared

with the Dancoff-Ginsberg correction factor to analyze the errors involved. (C.J.G.)

758

SOLUTION OF THE P_3 EQUATIONS IN ONE AND TWO DIMENSIONS. J. Davis, E. Gelbard, and J. Pearson (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng. 6, 251-2(1959) Sept.

Extensions of the basic FLIP technique are incorporated in the IBM-704 CLIP code, which numerically solves the one-group, one-dimensional P_3 equations in cylindrical geometry, and the IBM-704 TRIP code which numerically solves the one-group, two-dimensional P_3 code in Cartesian coordinates. A discussion of the time necessary to process input and output data for either code is given. (C.J.G.)

759

NONLOCAL THEORY OF THE COMPTON EFFECT. A. M. Longoni (Università, Turin). Nuovo cimento (10) 13, 802-8(1959) Aug. 16. (In Italian)

An attempt is made to apply the nonlocal theory proposed by G. Wataghin to the Compton effect. The asymptotic behavior of the differential cross section was studied by means of this theory. (auth)

760

INVESTIGATION OF THE SCINTILLATION PROPER-TIES OF SOME 1,3,4—OXADIAZOLE DERIVATIVES. N. P. Shimanskaya (Shimanskaia), A. P. Kilimov, and A. P. Grekov. Optics and Spectroscopy (English Translation) 6, 124-5(1959) Feb.

The compounds 2-(naphthyl)-5-(4-biphenylyl)-1,3,4-oxadiazole (LNBD), 2-(4-metoxyphenyl)-5-phenyl-1,3,4-oxadiazole (MtPPD) were synthesized and also 1-(1-naphthyl)-2-(4-biphenylyl)-hydrazine and 1-(4-methoxyphenyl)-2-phenylhydrazine which are the initial products in the production of the above-mentioned oxadiazoles. The spectral and scintillation characteristics of solutions of the substances LNBD, MtPPD, and PBD in toluene and polystyrene were studied. (auth)

761

SPECTROGRAPHIC INVESTIGATION OF THE STATE OF A GAS BEHIND A SHOCKWAVE. [PART] I. N. N. Sobolev, A. V. Potapov, V. F. Kitaeva, F. S. Faizullov, V. N. Aliamovskii, E. T. Antropov, and I. L. Isaev. Optics and Spectroscopy (English Translation) 6, 185-92 (1959) Mar.

A series of systematic experiments were carried out to determine the air temperature behind a shock wave according to the relative intensity of non-resonance Na and Li lines for wave velocities of 3 to 4 km/sec. Sodium and lithium were introduced into a shock tube in the form of NaCl and LiCl. It was established that the large scatter in the experimental results depended on reabsorption, whose degree varied from experiment to experiment. The considerable concentrations of dyestuffs in the air, which was required to produce measurable line intensities, lead to reduced values of the temperature in comparison with the theoretical values. An added reason is the inhomogeneous cross-sectional distribution of the coloring material. It appears to be concentrated near the cold wall of the shock-tube. In order to eliminate this inhomogeneity effect in a subsequent series of experiments, dicyanogen was added to the air and the temperature was determined according to the relative intensity of the vibrational bands of cyanogen with unresolved rotational structure. A large series of experiments showed that different pairs of

bands lead to significantly different temperatures. The scatter being observed cannot be explained by just the reabsorption, but is apparently also related to the lag in the equilibrium build-up in the vibrational degrees of freedom of the cyanogen. (auth)

762

THE LATTICE SPECIFIC HEATS OF SOLID HYDROGEN AND DEUTERIUM. R. W. Hill and O. V. Lounasmaa (Clarendon Lab., Oxford). Phil. Mag. (8) 4, 785-96 (1959) July.

Measurements of the specific heats of solid para-hydrogen and orthodeuterium in the temperature range from 2 to 18°K are described. Anomalous contributions arising from orthohydrogen and paradeuterium impurities were minimized by converting the specimens catalytically in the liquid state, but could only be made negligible for hydrogen. The specific heat at constant volume is deduced for each substance, and its temperature variation discussed in terms of a reduced Debye temperature. It is shown that the behavior of both substances is very similar to that calculated by Leighton (1948) for crystals of fcc structure. (auth)

763

THE SPECIFIC HEAT OF CERIUM MAGNESIUM NITRATE BELOW 10°K. C. A. Bailey (Clarendon Lab., Oxford). Phil. Mag. (8) 4, 833-5(1959) July.

The specific heat of cerium magnesium nitrate was measured in the range 1.5 to 10°K where the magnetic specific heat is negligible compared with the lattice specific heat. It was found that above 3°K the lattice specific heat cannot be represented by a single Debye term but below this temperature it is given by $C_L = 1.13 \times 10^{-3} RT^3$. (auth)

764

OPTICAL TRANSITION RADIATION FROM PROTONS ENTERING METAL SURFACES. P. Goldsmith and J. V. Jelley (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phil. Mag. (8) 4, 836-44(1959) July.

Transition radiation is the term adopted to describe a feeble radiation emitted when a charged particle crosses the boundary between two media having different optical properties. Experiments are described to establish the existence of this effect. The results, obtained from studies of the polarization of the radiation, its excitation function and its absolute yield, confirm the predictions of theory. (auth)

765

GROWTH OF ELECTRON SPACE-CHARGE AND RADIO WAVES IN MOVING ION STREAMS. R. Q. Twiss (Oxford and Cambridge Univ. Club, London). Phil. Mag. (8) 4, 868-75(1959) July.

A criticism is given of a recent paper by Piddington with the same title. It is shown that his belief that the growing waves in a two-stream electron wave tube are really evanescent is untenable and that his own theory is effectively equivalent to the conventional one in which these growing waves are identified as being true amplified waves. Piddington's conclusion that an initial disturbance in a two-stream medium will grow exponentially with time without oscillation is shown to be a consequence of highly idealized assumptions as to the nature of the medium and as to the initial and boundary conditions. In any practical case it is argued that double stream flow will build up oscillations at frequencies, in general around the plasma frequency, rather than pro-

duce charge separated blobs as in Piddington's theory. If temperature effects are allowed for, it is shown that double stream flow does not occur in the corona in the case discussed by Piddington and reasons are also given for rejecting a theory of growing waves in shock fronts advanced by Sen. Piddington's reasons for rejecting the existence at transverse space charge waves in a drifting ionized medium and for denying that growing evanescent waves can be excited by reflection are shown to be invalid. This removes Piddington's objection to an earlier theory of excess solar radio wave, but it is agreed that this theory must now be rejected on other grounds. (auth)

766

GROUND STATE OF LIQUID HELIUM. Ira L. Karp (Boeing Airplane Co., Seattle). Phys. Rev. 115, 223-6 (1959) July 15.

A calculation scheme suitable for studying the ground state of many-body Bose quantum systems with strong forces is developed. The calculation scheme is based on the nodeless property of the ground-state wave function and is capable of yielding in some cases upper and lower bounds on the ground-state energy and corresponding wave functions. From a treatment of liquid helium in the ground state, including a short-range interaction form, it is concluded that the calculation scheme is suitable for problems with involved interactions and is capable of reducing the problem to the mathematical one of calculation of the energy and lattice structure of a classical crystal at absolute zero of temperature. (auth)

767

CRYSTAL STRUCTURE OF THE FERROELECTRIC PHASE OF (GLYCINE)$_3$·H$_2$SO$_4$. S. Hoshino, Y. Okaya, and R. Pepinsky (Pennsylvania State Univ., University Park and Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 115, 323-30(1959) July 15.

Ferroelectric (glycine)$_3$·H$_2$SO$_4$ crystallizes at room temperature in the monoclinic system with a = 9.41$_7$A, b = 12.64$_5$A, c= 5.73$_5$A, β = 110°23'; the space group is P2$_1$, and the polar direction is along the two-fold screw axis. Above 47°C the spontaneous polarization disappears as the space group becomes P2$_1$/m. The crystal structure was determined from full three-dimensional x-ray diffraction data, using Cu Kα radiation. Out of the three glycine molecules in the crystal, one has the usual zwitter-ion configuration, with the —NH$_3^+$ group out of the plane of the other atoms; the remaining two glycines are mono-protonated, and planar within experimental error, and are designated as glycinium ions. Thus the chemical formula is properly written as (NH$_3^+$CH$_2$COO$^-$)·(NH$_3^+$CH$_2$COOH)$_2$·SO$_4^{--}$, and the compound is best described by the chemical name glycine diglycinium sulfate. One of the planar glycinium ions lies near but not in the plane y = $^1/_4$, which becomes the mirror plane in the high-temperature phase. The nitrogen atoms form N—H··O hydrogen bonds of the usual strength, whereas a quite strong O—H··O hydrogen bond of a distance of 2.43$_8$ A is found between the oxygen atom of the carboxyl group of the zwitter-ion glycine and that of the planar glycinium ion which lies near the plane y = $^1/_2$. Above the Curie point, at 47°C, mirror symmetry is attained by statistical arrangement of atoms around the mirror planes at y = $^1/_4$ and $^3/_4$. The disorder of the glycinium ions near the mirror planes, and the above-mentioned strong O—H··O bond, are of particular importance for the ferroelectric behavior of the crystal. (auth)

768

GROUND STATE OF THE HELIUM ATOM. II. Toichiro Kinoshita (Bell Telephone Labs., Murray Hill, N. J. and Cornell Univ., Ithaca, N. Y.). Phys. Rev. 115, 366-74 (1959) July 15.

A further attempt is made to improve the theoretical prediction of the energy of the ground state of atomic helium. The nonrelativistic part is treated by the variational method of Stevenson and Crawford which is useful for improving the lower bound for the ground-state energy. Linear combinations of up to 80 terms of generalized Hylleraas type are employed in the numerical computation. The best trial function gives -2.9037237 atomic units as an upper bound and -2.9037467 atomic units as a lower bound for the ground-state energy. It is estimated from the calculated results that the exact nonrelativistic energy of He ground state will be found in the neighborhood of -2.9037247 atomic units. Rigorous formulas are derived which can be used for calculating the upper limits to the errors in the expectation values of mass polarization and relativistic corrections. Although these formulas give very broad limits of error, they are useful in estimating the order of magnitude of actual errors in a semiempirical manner. With mass polarization and relativistic corrections as well as electrodynamical corrections, the theoretical ionization potential becomes 198310.77 cm^{-1} which is in good agreement with the latest observed value 198310.82 ± 0.15 cm^{-1} (auth)

769

OPTICAL PROPERTIES OF ACTIVATED AND UNACTIVATED HEXAGONAL ZnS SINGLE CRYSTALS. S. P. Keller and G. D. Pettit (International Business Machines Corp., Poughkeepsie, N. Y.). Phys. Rev. 115, 526-36(1959) Aug. 1.

Single crystals of hexagonal ZnS, unactivated and activated with Cu, Al, or Mn, were examined. The polarization effects in the transmission spectrum of unactivated ZnS were measured further into the fundamental absorption than were previously measured. The theoretical prediction that, for direct transitions at k = 0, light polarized perpendicular to the c axis is more strongly absorbed than light polarized parallel to the c axis is born out throughout the fundamental absorption region except in the wavelength region between 290 and 325 mμ. The wavelength dependence and the polarization of the excitation and fluorescence spectra of the activated and unactivated crystals were measured at room temperature and at 77°K. The excitation spectra showed an agreement with the selection rule at the edge of the fundamental absorption, but there was a reversal of the selection rule deep in the absorption region. There was also an impurity absorption exhibiting the same polarization properties as the edge. Some fluorescent emissions were polarized perpendicular and some were polarized parallel to the c axis. Speculations are made on the reversal of the polarization deep in the fundamental absorption and on the symmetry and the nature of the sites causing the various fluorescence bands.(auth)

770

CRYSTAL ATOM SPACING AND THE WAVELENGTH OF AN INCIDENT ATOM BEAM. Robert E. Davidson (Langley Aeronautical Lab., Langley Field, Va.). Phys. Rev. 115, 570-4(1959) Aug. 1.

A beam of atoms is assumed to be incident on a crystal, and a certain aspect of the energy exchange is investigated insofar as is possible without elaborate experiments or calculations. The interaction potential is assumed to be that for helium and lithium fluoride and is known from other sources. By taking account of thermal motion of the crystal atoms tangentially to the surface of the crystal, it is deduced that the probability that the beam will give up energy to the surface becomes relatively large when the de Broglie wavelength of the tangential component of beam moment is decreased to the same order of magnitude as the spacing of atoms in the crystal. (auth)

771

STRUCTURE OF THE VERTEX FUNCTION. Stanley Deser, Walter Gilbert, and E. C. G. Sudarshan (Harvard Univ., Cambridge, Mass.). Phys. Rev. 115, 731-5(1959) Aug. 1.

An integral representation as a function of invariants is found for the Fourier transform of the matrix element between the vacuum and a one-particle state of the retarded commutator of two currents. A special case is a spectral representation for the vertex as a function of momentum transfer. The threshold in this representation is lower than that found in the usual perturbation theory. (auth)

772

QUADRUPOLE SELECTION RULE IN IRON GROUP SPIN-PHONON INTERACTIONS. R. D. Mattuck and M. W. P. Strandberg (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Letters 3, 369-70(1959) Oct. 15.

A fact is pointed out which has not been explicitly stated in the literature and which has important experimental implications, that spin-phonon transitions in non S-state iron-group paramagnets obey quadrupole selection rules. This means that for odd half-integer spin systems of $S > \frac{1}{2}$, the direct spin-phonon transition is approximately forbidden between any pair of spin states, $|1\rangle$, $|2\rangle$. Cr^{+++} ($S = \frac{3}{2}$) in ruby is considered as an example. (W.D.M.)

773

EDGE AND IMPURITY EMISSION IN CADMIUM SULFIDE. Douglas M. Warschauer and Donald C. Reynolds (Wright Patterson AFB, Ohio). Phys. Rev. Letters 3, 370-2(1959) Oct. 15.

A model was recently proposed for the band structure of CdS which purports to explain much of the observed optical phenomena in terms of conduction and valence band extrema centered around k = 0. A set of observations is described which cannot be explained in terms of this simple structure. (W.D.M.)

774

ZEEMAN SPLITTING OF EXCITON LINES IN CdS. R. G. Wheeler and J. O. Dimmock (Yale Univ., New Haven). Phys. Rev. Letters 3, 372-4(1959) Oct. 15.

The twofold splitting of three absorption lines in CdS in the wave-length region greater than 4840 A is reported. All other lines observed do not split in fields up to 19 kilogauss. The g values of the lines are dependent upon the orientation of the magnetic field with respect to the c axis of the crystal. Also observed was a small shift in the mean position of the split lines which is approximately quadratic with magnetic field strength. (W.D.M.)

775

METHOD FOR PRODUCING ALIGNED DEUTERONS. M. E. Rose (Oak Ridge National Lab., Tenn.). Phys. Rev. Letters 3, 387(1959) Oct. 15.

A method is described for the production of an aligned beam of deuterons. The principle of the method is based on the fact that when thermal neutrons are captured in hydrogen, the emerging deuterons are automatically aligned along their direction of motion. In addition, since the capture takes place primarily through the $^1S_0$ state, the alignment is almost complete. The emerging deuterons are of 1.3 kev energy, however, acceleration is feasible. (W.D.M.)

776

HEAT CAPACITY OF ^{3}He$-^4$He SOLUTIONS. R. De Bruyn Ouboter, K. W. Taconis, and C. Le Pair (Kamerlingh Onnes Laboratorium, Leiden). Physica 25, 723-4(1959) Aug.

The heat capacity of He^3−He^4 mixtures was measured over the complete concentration range. A discontinuity was found in the specific heat at the corresponding lambda temperature. The lambda temperatures obtained are in good agreement with the known lambda line. (C.J.G.)

777

EXCITATION OF N_2 AND O_2 BY $\frac{1}{2}$ AND 1 MEV PROTONS. R. W. Nicholls, E. M. Reeves, and D. A. Bromley (Univ. of Western Ontario and Atomic Energy of Canada Ltd., Chalk River, Ont.). Proc. Phys. Soc. (London) 74, 87-91(1959) July.

Spectroscopic observations were made photographically, over the wavelength range from 3800 to 8000 A, upon the luminosity produced by 0.5 and 1 Mev proton beams in N_2, over the pressure range 63 μ Hg to atmospheric, and in O_2 at atmospheric pressure. The spectra excited in N_2 consisted entirely of bands of the N_2 first positive ($B^3\Pi-A^3\Sigma$) and second positive ($C^3\Pi-B^3\Pi$) systems, and of the N_2^+ first negative ($B^2\Sigma-X^2\Sigma$) system. No atomic lines of H_I, N_I, or N_{II} were found. In contrast, the spectra excited in O_2 consisted solely of lines of O_I and O_{II}. No bands of O_2 or O_2^+ were found. The probable excitation mechanisms of these spectral features are discussed. (auth)

778

GRAPHICO-ANALYTICAL CONSTRUCTION OF THE TRAJECTORIES OF CHARGED PARTICLES IN AXIALLY SYMMETRICAL ELECTRIC AND MAGNETIC FIELDS. N. I. Shtepa. Radiotekh. i Elektron. 4, 695-702(1959).

779

THE ARGUS EXPERIMENT. Trans. Am. Geophys. Union 40, 301-11(1959) Sept.

A review of the Argus Experiment is presented. Theory of geomagnetic electron trapping is discussed followed by summary of Argus Organizations. Data from satellite observations are tabulated and information from optical, radio, and magnetic observations are included. The information gained by this experiment is a basis of better understanding of natural trapping in the Van Allen radiation regions, and related phenomena such as the aurora. (J.R.D.)

780

ANALOG SIMULATION OF MAGNETOHYDRODYNAMIC PHENOMENA IN MOLTEN METALS. I. M. Kirko. Trudy Inst. Fiz. Akad. Nauk Latv. S.S.S. 8, 3-23(1956). (Translated from Referat. Zhur. Met., No. 11, 1957, p.35).

Magnetohydrodynamic phenomena are described by a nonlinear system of Maxwellian equations for moving mediums, the Navier-Stokes equations, and the equations of continuity. In view of the difficulties inherent in the analytical integration of these equations, the possibility of application of the similarity methods and analog simulation thereto are examined. Questions of the analog devices such as those with constant electrical and magnetic boundary fields, those with fields constituting harmonic time functions, and those with a given traveling magnetic-wave field were examined. Also analyzed is the question of molten metal behavior in the phenomena of heat transfer in forced flow, the phenomena of convection due to the presence of gravity, and thermal expansion of the metal being ignored.

781

A METHOD OF PRODUCING POWER FROM BETA-ACTIVE ISOTOPES. G. I. Rukman, V. P. Tychinskii, Ya. A. Yukhvidin. Trudy Nauch. Issledovatel'. Inst. Ministerstva Radiotekh. Prom. S.S.S.R., No. 6, 3-8 (1956). (Translated from Referat. Zhur. Elektrotekh., No. 2, 1958, p.118).

An atomic power source is suggested, based on the charge accumulation created by β-radiation in an electric capacitor. A charged capacitor is periodically discharged by a switching device onto an impulse transformer, the secondary winding of which supplies a load. A scheme of an atomic battery is also presented, its power and efficiency are calculated on the basis of a 10^5 curie β-source activity, with an average β-particle energy of 100-kev, and a 100-$\mu\mu$f capacitor, the optimum charging time that corresponds to the maximum efficiency (20.5%) is 20 microseconds, the capacitor voltage is 70 kv, and the mean output power is 13 w. With a 10 : 1 transformer ratio, the equivalent battery resistance is on the order of hundreds of ohms. The S^{35} sulfur isotope, with an average energy of about 100 kev and a half-life of 87.1 days, is recommended as a source of β-radiation.

782

THE RADIATION PATTERN OF A RADIATOR PLACED NEAR AN ELLIPTICAL CYLINDER AS A FUNCTION OF THE CYLINDER PARAMETERS. G. N. Kocherzhevskii and N. P. Brusentsov. Trudy Moskov. Energet. Inst. 21, 32-48(1956).

Radiation directivity is examined for cases such as an electric radiator oriented along the axis of the elliptical cylinder, an electric radiator oriented at right angles with the axis of the elliptical cylinder, and a magnetic radiator oriented along the cylinder axis (a longitudinal slot), and placed on the surface of the elliptical cylinder. For formula derivation, the field is determined in the space surrounding the cylinder as a function of incidence angles of a plane wave at the cylinder. A radiation pattern of a receiving antenna placed at some point is determined, from the principle of reciprocity, the radiation pattern of the radiator placed near the cylinder is determined. Formulas are presented for calculating the radiation patterns in a plane perpendicular to the cylinder axis. The formulas establish a relationship between the radiation pattern and the size and parameters of the cylinder. Estimated radiation patterns are presented which illustrate the dependence of the radiation pattern on factors such as radiator placement with respect to the cylinder, eccentricity of the cylinder cross-section, cross-section perimeter, and cylinder-radiator distance. Experiments were needed to clarify how much of the error in calculations was due to the assumption of an infinitely long cylinder. A comparison of experimental data with

calculations showed that, with a short cylinder, the discrepancy is considerable, particularly in the rear half-space. A good agreement was obtained with cylinders up to 4λ long for the case of electric radiator and up to 2λ long for the slot (in the latter case, the cylinder turned into a strip, because the elliptic cylinder had unity eccentricity). (TCO)

783

ON LIMITED SENSITIVITY OF PHOTOGRAPHIC EMULSION FOR IONIZING CORPUSCLES. K. S. Bogomolov. Zhur. Nauch. Priklad. Fot. i Kinematografii 4, 299-300(1959).

References on the energy calculation for ionizing corpuscles and the sensitivity of photographic emulsions for these corpuscles are given. The results show, that N-electrons of Br, have some influence on the density of corpuscles traces only at especially high values of true sensitivity. (TCO)

784

ON THE QUESTION OF THE DEPENDENCY BETWEEN THE ELECTRON SENSITIVITY OF NUCLEAR PHOTOGRAPHIC EMULSIONS AND THE DIMENSIONS OF AgBr GRAINS. V. I. Zakharov and N. A. Perfilov. Zhur. Nauch. Priklad. Fot. i Kinematografii 4, 300-1 (1959).

A study on the quotient φ, which is determined by the equation $\varphi = (S/cd)$, is presented where S is the electron sensitivity of nuclear emulsion, c is the AgHal concentration by weight and d is the average diameter of the grain. The quotient for smaller dimensions of microcrystals of AgBr (d = 0.03 μ) were also investigated. Grains of different dimensions were centrifuged out of the emulsion. The photographic layer was exposed by electrons with an energy of 1 kev. The electrons were radiated from the radioactive isotopes Tl^{204}_{81} with the help of a magnetic spectrometer. Experimental results are presented graphically. (TCO)

785

ON THE THEORY OF LONGITUDINAL OSCILLATIONS OF ELECTRONIC-IONIC BEAM. R. V. Polovin and N. L. Tsintsadze (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Tekh. Fiz. 29, 831-2(1959) July. (In Russian)

Generalization is developed for random beam perturbations of $f(r)e^{i(\omega t - \mu \varphi - \gamma z)}$ (μ is an integer) based on previously obtained data for longitudinal electromagnetic oscillations of electron-ion beams in a strong magnetic field with beam perturbation of the $f(r)e^{i(\omega t - \gamma z)}$ type. In cases when $\mu = \pm 1$, the deformation is of a zigzag type; with $\mu \geq 2$ it is spiral. (R.V.J.)

786

RADIOLOGICKÁ FYSIKA. (Radiological Physics, 2nd ed., rev. and enlarged). Frantisek Běhounek, Antonin Bohun, and Josef Klumpar. Prague, SNTL, 1958. 423p.

A manual is presented which gives a simple introduction to nuclear physics and a general coverage of the field of radiation physics. The theory of radiology is given as well as the application of radiation techniques in industry, biology, chemistry, and medicine. (TCO)

787

ISSLEDOVANIYA V OBLASTI ELEKTRICHESKOGO RAZRYADA V GAZAKH. (Research in the Field of Electric Discharge in Gases). B. N. Klyarfeld, I. V. Antik, and N. I. Borunov, eds. Moscow, Gosenergoizdat, 1958. 239p.

A collection comprising research papers on problems of applied physics of electric discharge in gases is presented. Information is included on formation of an electric discharge when high voltages are applied to the electrodes of gas-discharge tubes, the behavior and properties of cathode spot formation on the mercury surfaces, methods of investigating gas density during passage of large currents through the discharge tubes, and density distribution of current on plate surfaces of mercury rectifiers. (TCO)

Cosmic Radiation

788   AFOSR-TN-59-168

Maryland. Univ., College Park.
SUMMARY OF RESULTS OF RESEARCH STUDY CONDUCTED UNDER PROVISIONS OF CONTRACT AF18-(600)-1038, PROJECT NO. 9774-37665. [1959]. 20p. (AD-211147).

During the performance of the contract, a great deal of theoretical work was done on various aspects of cosmic rays and auroral particles, in particular their behavior in magnetic fields, on cosmic-ray albedo, and on the trapping of particles in the earth's dipole field. The results are discussed briefly. Experimental work is summarized on extending the knowledge of cosmic-ray variations down to a time scale of about one second and to correlate these variations for different primary energies and to extend them to the very lowest energies. (W.D.M.)

789

FIRST AND SECOND HARMONICS OF THE DAILY VARIATION OF THE COSMIC RAY NUCLEONIC COMPONENT AT UPPSALA AUG. 31, 1956 TO AUG. 31, 1957. Arne Eld Sandström and Stig Lindgren (Universitet, Uppsala). Arkiv Fysik 16, 137-51(1959).

An analysis of the daily variation of the cosmic ray nucleonic component at Uppsala for August 31, 1956 to August 31, 1957 is presented. To study the correlation with geomagnetic activity, the days were divided into five classes according to their K_p-indices. The first and second harmonics for each class of days were determined for the period Aug. 31, 1956 to Aug. 31, 1957. The disturbing influence of the sharp intensity drop following the onset of a Forbush decrease concerning the daily variation is discussed. The influence is found to be negligible not only as far as the yearly mean is concerned but also as regards the 27 days sun rotation periods. The influence becomes serious only in the case of the most disturbed days when phase and amplitude are studied as functions of the K_p-index. The mean value of the time of maximum is found to be 1300 GMT for the first harmonic and 0530 GMT for the second harmonic. The yearly mean of the amplitude is 0.32% in the first case and 0.034% in the second. The dependence of phase and amplitude on the K_p-index is very small. (auth)

790

THE ONSET TIMES OF FORBUSH-TYPE COSMIC RAY INTENSITY DECREASES. A. G. Fenton, K. G. McCracken, D. C. Rose, and B. G. Wilson (Univ. of Tasmania, Hobart, Australia and National Research Council, Ottawa). Can. J. Phys. 37, 970-82(1959) Sept.

The onset times of a number of Forbush-type decreases observed at four widely spaced stations are

compared, and it is shown that appreciable differences occur. The stations selected were Hobart, Mawson, Ottawa, and Sulphur Mountain. It was found that a consistent pattern is obtained for the events studied when the onset times are plotted as a function of the direction of maximum sensitivity of the recorders relative to the earth-sun line. This is interpreted as being due to a directional anisotropy that exists in the mechanism producing the decreases, at least in the early stages. The depression occurs first for particles arriving from directions between 30° and 120° west of the earth-sun line. The relation between these observations and geomagnetic disturbances and the quiet-day daily variation is discussed. (auth)

791

A COMPARISON OF THE COSMIC-RAY INTENSITY AT HIGH ALTITUDES WITH THE NUCLEONIC COMPONENT AT GROUND ELEVATION. J. E. Henkel, J. A. Lockwood, and J. H. Trainor (Univ. of New Hampshire, Durham). J. Geophys. Research 64, 1427-38(1959) Oct.

A series of balloon-borne soundings in the atmosphere with single Geiger tubes was made during the period January to September 1958. The counting rate determined at the Pfotzer maximum is compared with that recorded by the nucleonic detector at Mt. Washington (1909 m; $\lambda = 55°N$). Large changes in the counting rate of each detector were observed, and the ratio of these changes is ~2 to 1. Several large deviations from this normal ratio were also observed; they occur for flights on which the shape of the intensity-altitude curve near the Pfotzer maximum is quite different from the normal. The changes are explained either in terms of depressions of the low-energy portion of the cosmic-ray spectrum following marked decreases in the nucleonic component or by the presence of excess low-energy radiation. An anomalous increase of ~100% observed at high altitudes during one flight is attributed to high-energy x radiation. It is found that the hemispherical average unidirectional intensity above the atmosphere derived from the counting rate at the Pfotzer maximum has decreased ~200% from 1954 to 1958 at $\lambda = 53°N$, and this change is compared with results at other latitudes. (auth)

792

SATELLITE OBSERVATIONS OF SOLAR COSMIC RAYS. Pamela Rothwell and Carl McIlwain (State Univ. of Iowa, Iowa City). Nature 184, 138-40(1959) July 18.

On three occasions during August 1958, large increases in the intensity of charged particles outside the Van Allen radiation zones were detected by the Explorer IV satellite 1958 epsilon, at high magnetic latitudes and rather low satellite altitudes where the Geiger tubes carried in the satellite normally count only cosmic rays. Examination of counting data shows the particle fluxes are at least one or two orders of magnitude greater than the normal cosmic ray flux. Evidence is presented that these intensity increases are not due to soft particles from the outer Van Allen radiation zone, but are due to solar protons associated with the large solar flares which occurred on August 16, 22, and 26. Strong support for this suggestion is provided by measurements made from balloons and with riometers during this period. (C.H.)

793

RADIATION OBSERVATIONS WITH SATELLITE 1958 OVER AUSTRALIA. A. J. Herz, K. W. Ogilvie, and

J. Olley (Univ. of Sydney) and R. B. White (Commonwealth Scientific and Industrial Research Organization, Sydney). Nature 184, 391-5(1959) Aug. 8.

The scintillation counter of Sputnik III is described and data received from it by University of Sydney observers is reported, though incomplete and analyzed. (T.R.H.)

794

CHANGE OF COSMIC RAYS IN SPACE. H. V. Neher (California Inst. of Tech., Pasadena). Nature 184, 423-5(1959) Aug. 8.

Variations in cosmic-ray activity based on data taken between 1954 and 1958 are given and discussed. (T.R.H.)

795

THE UPPER BOUNDARY OF THE VAN ALLEN RADIATION BELTS. Conway W. Snyder (California Inst. of Tech., Pasadena). Nature 184, Suppl. 7, 439-40(1959) Aug. 8.

The Van Allen belt measurements of Pioneers III and IV and Mechta are discussed. (T.R.H.)

796

THE SENN NUCLEAR POWER STATION—EUROPE'S FIRST FULL-SCALE BWR. V. A. Elliott and G. J. Stathakis. Nuclear Power 4, No. 42, 87-91(1959) Oct.

A description is given of the 150 Mw nuclear power station to be located near Naples. The dual-cycle boiling water reactor system is to be fuelled with Zircaloy-clad, uranium oxide pellets and moderated and cooled with light water. Arrangement of facilities, economics, and safeguards of the plant are discussed. (C.J.G.)

797

CLOUD CHAMBER STUDY OF PENETRATING SHOWERS UNDERGROUND. S. Higashi, S. Mitani, T. Oshio, H. Shibata, K. Watanabe, and Y. Watase (Osaka City Univ.). Nuovo cimento (10) 13, 265-83 (1959) July 16.

A multiplate cloud chamber containing fifteen lead plates 1-cm thick was used to observe penetrating showers underground. Fifteen and twenty-three penetrating showers, having four secondary shower particles on the average, were obtained during 667.9 hours and 3603.1 hours at 50 mwe and 250 mwe, respectively. Special attention was paid to distinguish penetrating showers produced by μ mesons from those by the nucleonic component, the chamber of large width (100 cm) having been set as close to the upper wall in the tunnel as possible. Almost all of the observed showers produced by isolated incident particles are considered as probably produced by μ mesons (named P-showers phenomenologically), and those by one of two or more incident particles as due to the nucleonic component (named S-showers), since the mfp of the nucleonic component for nuclear interaction is about 10^{-4} times shorter than that of μ mesons. After correcting for the triggering efficiency of the apparatus, the ratios of frequencies of S-showers to that of P-showers are 1.1 ± 0.3 and 0.92 ± 0.23 at both depths, which means that a half of the high energy nuclear interactions underground is produced by the nucleonic component. The depth dependence of frequencies of P-showers is compared with the prediction by Weizsäcker and Williams' treatment of μ-meson interactions. It was observed that P-showers have a characteristic different from that of S-showers, i.e., the average number of

heavily ionizing secondaries of P-showers is 0.3 per shower, while the value of S-showers is 2.8 per shower. (auth)

798

ON THE RADIATION OF MESONS WITH A CONSTANT TRANSVERSE MOMENTUM P_T IN COSMIC RAY JETS. G. Yekutieli (Weizmann Inst. of Science, Rehovoth, Israel). Nuovo cimento (10) 13, 446-7(1959) July 16.

It has been observed in high-energy nuclear interactions (E ≥ 1000 Bev) that mesons are produced with a constant transverse momentum $P_T \approx 0.4$ Bev. The resemblance of this observation to Cherenkov Radiation is discussed. (C.J.G.)

799

THEORETICAL STUDY OF THE COSMIC RAY EQUATOR. P. J. Kellogg and M. Schwartz (Univ. of Minnesota, Minneapolis). Nuovo cimento (10) 13, 761-8(1959) Aug. 16.

Calculations of cut-off rigidities for cosmic-ray particles in the earth's magnetic field were carried out, using an approximation to the earth's field which includes all moments up to and including the octupole moments. The results show that deviations of the cosmic ray intensity from that calculated on the dipole approximation may be ascribed to the higher moments of the earth's field. (auth)

800

NUCLEAR INTERACTION OF HEAVY PRIMARY COSMIC RADIATION. P. L. Jain (Univ. of Buffalo). Nuovo cimento (10) 13, 839-48(1959) Aug. 16.

In a stack of 30 nuclear emulsions exposed to cosmic radiation near the geomagnetic equator, 65 tracks of heavy primary nuclei were located. Out of the total 65 tracks of heavy nuclei, 24 exhibited interactions with the nucleons of the emulsion. In 19 of these 24 interactions primary particles break up into fragments of charge −2. The charge of these particles is determined by δ-ray counting and from gap length distribution while the energy per nucleon is found from the relative scattering method and from the opening angle of the fragments. (auth)

801

DAY TO DAY ANALYSIS OF THE COSMIC RAY DIURNAL WAVE IN 1958. J. F. Steljes (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Nuovo cimento (10) 13, 857-63(1959) Aug. 16.

The fluctuations of the amplitude and phase of the diurnal wave are shown from data gathered at various I.G.Y. cosmic radiation stations in March, June, and August. Enhanced diurnal variations are shown in data taken at Deep River, Ontario, Canada on March 25, June 19, and in August 1958. Diurnal variations are compared graphically for nearby and distant I.G.Y. stations. (C.J.G.)

802

HEAVY NUCLEI AND α PARTICLES BETWEEN 7 ANI 100 BEV/NUCLEON. I. INTERACTION MEAN FREE PATHS AND FRAGMENTATION PROBABILITIES. E. Lohrmann and M. W. Teucher (Univ. of Chicago). Phys. Rev. 115, 636-42(1959) Aug. 1.

In a stack of nuclear emulsion exposed to the cosmic radiation near the geomagnetic equator, 540 tracks of heavy nuclei were located in a systematic scan and followed along the track. Twenty-two interactions of light (3 ≤ Z ≤ 5), 218 of medium (6 ≤ Z ≤ 9), and 99 of heavy

(Z ≥ 10) nuclei were found. The average energy of the nuclei in this experiment was about 20 Bev per nucleon. The interaction mean free paths for all charge groups are in reasonably good agreement with results obtained at lower energies, indicating that the mean free path is independent of energy within the limits of error. In addition, all the α particles originating in fragmentations of heavy nuclei were followed. The mean free path of α particles resulting from fragmentations is again in agreement with results obtained at lower energies. The same is true for the fragmentation probabilities. Fragmentation probabilities in hydrogen are given and their significance is discussed. (auth)

803

HEAVY NUCLEI AND α PARTICLES BETWEEN 7 AND 100 BEV/NUCLEON. II. FRAGMENTATIONS AND MESON PRODUCTION. P. L. Jain, E. Lohrmann, and M. W. Teucher (Univ. of Chicago). Phys. Rev. 115, 643-54(1959) Aug. 1.

Three hundred seventeen heavy-nuclei and 175 α-particle interactions of more than 7 Bev/nucleon were found in a systematic way and analyzed. Average values and fluctuations of the individual values for the energy of heavy nuclei were obtained. At an average energy of 10 Bev/nucleon and 40 Bev/nucleon the average number of charged mesons produced by α-particle interactions with emulsion nuclei was found to be 4.6 and 8.2, respectively. About one-half of the nucleons of the α particle participate in the collision. The meson multiplicities per participating nucleon agree for proton and α-particle collisions at 10 Bev/nucleon. The angular distribution of the shower particles emitted from the interactions was measured, and the energy of the interactions from the angular distribution was calculated by using the median angle formula or equivalent formulas, based on the "meson spectrum independent" approximation. These methods overestimate the true primary energy on the average by a factor of 2 (for interactions with less than 5 heavily ionizing prongs). This is due to the relatively large proportion of slow mesons in the c.m. system. The distribution of primary energy as obtained by this method around the true value is shown for two groups having average energies of 10 Bev/nucleon and 40 Bev/nucleon. Equivalent results are given for the heavy-nuclei interactions. The average number of mesons produced in collisions between heavy nuclei and emulsion nuclei at an average energy of 20 Bev/nucleon is given. It increases with the charge of the incident nucleus in agreement with a crude geometrical model. (auth)

804

ENERGY SPECTRUM OF THE HEAVY NUCLEI IN THE COSMIC RADIATION BETWEEN 7- AND 100-BEV/NUCLEON. P. L. Jain, E. Lohrmann, and M. W. Teucher (Univ. of Chicago). Phys. Rev. 115, 654-9 (1959) Aug. 1.

The energy spectrum of the heavy nuclei of the cosmic radiation was determined between 7 Bev/nucleon and 100 Bev/nucleon. The distribution for the M(6 ≤ Z ≤ 9) and H(Z ≥ 10) charge groups agree with one another within the limits of error. Combining both charge groups, the integral spectrum is of the form $N(>E) \sim E^{-1.6 \pm 0.15}$ (E = total energy/nucleon). Flux values for nuclei of the M, H, and VH (Z ≥ 20) charge groups at the geomagnetic equator are given. Comparing these results with flux values obtained at high latitudes, it is concluded that a power spectrum of the

form $E^{-1.6}$ fits all three charge groups within the limits of error between 2.5 Bev/nucleon and 7 Bev/nucleon. From the observation of α-particle showers of very high energy we conclude that under certain assumptions the integral spectrum of α particles can be represented by $N(>E) \sim E^n$ with n = −1.58 for energies ≤1500 Bev/nucleon. (auth)

805

OBSERVATIONS OF SOLAR FLARE RADIATION AT HIGH LATITUDE DURING THE PERIOD JULY 10-17, 1959. R. R. Brown and R. G. D'Arcy (Univ. of California, Berkeley). Phys. Rev. Letters 3, 390-2(1959) Oct. 15.

Three cosmic-ray intensity increases were observed at balloon altitudes over College, Alaska, in association with solar flares of importance 3+ which occurred on July 10, 14, and 16, 1959. In addition to the cosmic-ray intensity increases briefly reported, the flares produced type III cosmic radio noise absorption events on 27.6 and 50 Mc/sec as well as sudden commencement magnetic storms. (W.D.M.)

806

UNUSUAL COSMIC-RAY FLUCTUATIONS ON JULY 17 AND 18, 1959. H. Carmichael and J. F. Steljes (Atomic Energy of Canada Ltd., Chalk River, Can.). Phys. Rev. Letters 3, 392-4(1959) Oct. 15.

Between July 11 and 18, 1959, a remarkable succession of three large Forbush decreases of cosmic-ray intensity occurred. The third of these decreases, which coincided with a magnetic storm beginning at 1638 UT on July 17, about 19 hours after a class 3+ solar flare observed from 2115 to 2230 on July 16, exhibited unusual features which are pointed out. Unusual features include very rapid changes in intensity. (W.D.M.)

807

THE NUCLEON CASCADE. Juan G. Roederer [Comisión Nacional de Energía Atomica, Buenos Aires]. Publs. com. nacl. energía atómica (Buenos Aires) Ser. fis. 1, No. 2, 39-73(1954). (In Spanish)

A theory of the nucleonic cascade is given paying special attention to latitude effects. In the first part the basic assumptions are discussed. In the second, the mathematical development is given, starting from the diffusion equations and using Budini-Molière's generation spectrum. Explicit expressions are derived for the development of the nucleonic cascade, assuming either a cut-off of primary spectrum of a pure potential form, or one of a "sectional form" as a better approximation to the real non-potential one. In the third part numerical results are given. All important features of the latitude effect of the nucleonic component as found by experiment are readily explained. Several curves are given, showing the absorptions of nucleons for different energy intervals, the variation of the absorption path with atmospheric depth and energy, the variation of the integral latitude effect for protons and neutrons as a function of energy and atmospheric depth, and the integral intensity of protons and neutrons as a function of geomagnetic latitude. (auth)

808

OBSERVATION OF SOLAR COSMIC RAYS. P. S. Freier, E. P. Ney, and J. R. Winckler (Univ. of Minnesota, Minneapolis). Trans. Am. Geophys. Union 40, 269-73(1959) Sept.

A report is given of the series of solar and terrestrial phenomena which occurred in late March 1958,

culminating in the arrival of low-energy cosmic rays at the earth. These results probably resulted from a solar flare of importance 3+. Significant features of this event are the presence of particles with rigidities lower than the normal cut-off for the geomagnetic latitude of Minneapolis, and the delayed arrival of cosmic rays following the solar flare of March 23. Hypotheses regarding these events are presented. (J.R.D.)

Criticality Studies

809   AERE-R/M-182

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
THE ANALYSIS OF EXPONENTIAL EXPERIMENTS. G. Brown, P. G. F. Moore, and R. Richmond. July 8, 1958. 16p. (NPCC/RPWP/P-119).

A description is given of the methods used by the BICEP group for the analysis of exponential experiments on graphite-moderated natural uranium lattices. These differ in some respects from the methods formerly employed at A.E.R.E. and resulted in a reduction by a factor of four in the time taken to carry out and analyze an experiment. (auth)

810   AERE-R/R-2731

United Kingdom Atomic Energy Authority. Atomic Energy Research Establishment, Harwell, Berks, England.
CRITICAL ASSEMBLIES WITH HEAVY WATER SOLUTIONS OF URANYL FLUORIDE (HAZEL). PART III. THEORETICAL ANALYSIS. C. Carter, P. K. H. Lang, and G. Myatt. July 1959. 15p. BIS.

Multigroup diffusion theory was used to analyze the critical size and neutron flux measurements obtained with uranyl fluoride—heavy water homogeneous critical assemblies. It is found that two-group theory is inadequate to explain the experimental data, but a reasonably good correlation can be made with a six-group theory. Alternatively, two-group theory can be adjusted to fit the data by using an artificially high slowing down area for heavy water. (auth)

811   ANL-6058

Argonne National Lab., Lemont, Ill.
CALCULATION OF THE TEMPERATURE DEPENDENCE OF Pu^{239}/U^{235} FISSION RATIO FOR A GRAPHITE-U^{235} SYSTEM. D. Meneghetti and K. E. Phillips. Sept. 1959. 15p. Contract W-31-109-eng-38. OTS.

The fission response per atom for a bare Pu^{239} detector divided by the fission response per atom for a bare U^{235} detector as a function of moderator temperature was calculated for a graphite-U^{235} homogeneous reactor having for the ratio of atomic densities $N^C/N^{U^{235}} = 12,500$. The dependence of the fission ratio upon moderator temperature depends upon the fact that, as the thermal distribution of the neutrons shifts toward higher energies with increasing core temperatures, the Pu^{239} neutron resonance at 0.297 ev increasingly contributes to the over-all fission response. The neutron spectrum corresponding to a given moderator temperature was estimated by the gaseous heavy moderator method described by Cohen. The effective mass of the carbon atom was assumed to be independent of temperature and equal to 11.9 neutron mass units. In the quantity $\Delta = 2m \Sigma_a/\Sigma_s$, where m is now the mass of the carbon atom in neutron mass units, the macroscopic

absorption and scattering cross sections, Σ_a and Σ_s, respectively, for the core at the energy kT were computed for various moderator temperatures assuming a $1/\sqrt{T}$ dependence of the absorption cross section of carbon and a $g(T)/\sqrt{T}$ dependence of the absorption cross section for U^{235}, where $g(T)$ are the Westcott non-$1/v$ factors. The asymptotic neutron distribution c/x^2, where c is a function of Δ and x is the velocity variable as defined by Cohen, was connected with the modified Maxwell distribution by extrapolation of c/x^2 to lower energies, followed by a simple smoothing out at the cross-over energy. (auth)

812   DP-407

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

PROCESS DEVELOPMENT PILE MEASUREMENTS OF LATTICE PARAMETERS OF NATURAL URANIUM IN HEAVY WATER. Norman P. Baumann. July 1959. 32p. Contract AT(07-2)-1. OTS

Details and complete results are given of a series of lattice studies performed in the Process Development Pile (PDP). The lattices studied covered a large range of configurations of natural uranium fuel in D_2O. Fuel assemblies consisted of single bare metal rods, clustered bare metal rods, clustered bare metal plates, metal tubes in aluminum housings, and clustered rods of aluminum-clad UO_2. Additional measurements were made with assemblies of metal plates inside gas-filled tubes. Triangular or equivalent lattice spacings were varied from 7.00 to 10.69 inches by the use of 7, 6, 5, 4, or 3 assemblies in the PDP test region. A detailed tabulation contains the measured bucklings and the moderator purity corrections for all lattices measured. The tabulation also includes calculated parameters, such as ϵ, p, f, L^2, and τ. Corrections required because of the irregular spacing of the test assemblies are discussed and listed for each lattice. The two-group, two-region method of analyzing critical water heights is described in detail. A comparison is made of the PDP measurements with similar measurements that were made at Chalk River, A.B. Atomenergi, Saclay, and North American Aviation. (auth)

813   NAA-SR-Memo-4267

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

PRELIMINARY POWER CALIBRATION OF THE OMR CRITICAL ASSEMBLY. R. J. Tuttle. Aug. 18, 1959. 6p. OTS.

The nuclear instrumentation of the OMR Critical Assembly was calibrated in terms of watts of thermal power. Calibration was necessary for comparison of radiation shielding calculations and to permit estimation of the flux for various experiments. Aluminum and cadmium covered gold foils were irradiated near the core to obtain the thermal flux. From this and several flux-averaging factors, power was calculated for instrument readings. (W.D.M.)

814   NAA-SR-Memo-4299

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

CRITICAL MASS CALCULATIONS—CORRECTION. R. A. Blaine. Aug. 28, 1959. 4p. OTS.

Cell flux distribution was recalculated for the organic moderated critical facility in order to correct critical mass predictions. The calculations were based on homogenizing the fuel cell and calculating average thermal properties. A critical loading of 32.6 elements

(thermal utilization 0.815) was obtained for a core with 7 cells empty. (W.D.M.)

815   NP-7980

Iowa State Coll., Ames.

FLUX DISTRIBUTION IN A UNIT CELL OF A URANIUM GRAPHITE SUBCRITICAL ASSEMBLY. (thesis). James Thomas Hayes. 1958. 116p.

The neutron flux distribution in a unit cell of the Iowa State College uranium-graphite subcritical assembly was investigated. Several techniques for flux measurements using the foil activation method were considered. The flux distribution was measured in three different directions inside the unit cell both with and without coolant. Experimental results were compared with the theoretical flux distribution. (W.D.M.)

816   NP-7981

Iowa State Coll., Ames.

EFFECT ON NEUTRON FLUX OF SOURCE GEOMETRY IN A URANIUM GRAPHITE SUBCRITICAL ASSEMBLY (thesis). Thomas Walker Nelson. 1957. 91p.

The problem of determining the optimum source conditions for the specific assembly at Iowa State College is treated. A variety of conditions were applied to the source and results and comparisons are presented. Results appear to verify that the presence of epithermal source neutrons in a subcritical assembly tends to lower the measured buckling whereas leakage at the base of an assembly raises buckling. (W.D.M.)

817   NP-7982

Iowa State Coll., Ames.

OPERATING CHARACTERISTICS OF A URANIUM GRAPHITE SUBCRITICAL ASSEMBLY (thesis). Fred Hubbard Baughman. 1957. 56p.

The operating characteristics of the subcritical assembly were determined using both small and large neutron sources. An 8.5 in. lattice resulted in higher flux levels and the largest value of the critical buckling. All experimental buckling determinations proved to be positive. There was no apparent flux depression due to indium foil loading. Horizontal flux distributions were symmetrical in both the x and y directions. (W.D.M.)

818   NP-7990

Iowa State Coll., Ames.

TRANSFER FUNCTION OF A URANIUM−GRAPHITE SUBCRITICAL ASSEMBLY (thesis). William John Ricci. 1958. 49p.

In practice, phase and amplitude relations, when considered as functions of the driving frequency, are collectively designated as the assembly transfer function. The parametric forcing or driving function in this case is source forcing, an imposed variation in the primary source. The transfer function determined experimentally agrees quite well with that predicted by the theory. A mean neutron lifetime in the assembly of approximately 0.07 sec and an effective multiplication factor of approximately 0.8 were determined. (W.D.M.)

819   NP-8000

Lockheed Nuclear Products, Marietta, Ga.

FLUX DISTRIBUTIONS AND CRITICALITY STUDIES FOR THE CRITICAL EXPERIMENT REACTOR. R. B. Shain. Sept. 1959. 32p. Contract AF33(600)-38947. (NR-64).

One- and two-dimensional flux distributions are given for the Critical Experiment Reactor using two-group diffusion theory. One-dimensional flux distributions

are shown for the two- and four-region reactor models along with two-dimensional iso-flux distributions. The calculated critical loading was found to be 18.6 fuel elements and is 0.6% lower than the experimentally-determined critical loading value. Values of K_{eff} for a 30- and 32-element core, using a two-dimensional, two-group diffusion theory program, are 1.106 and 1.130, respectively. One- and two-dimensional methods for calculating reactivities of the CER agree within 1%. (auth)

820   RFP-149
Dow Chemical Co. Rocky Flats Plant, Denver.
AN EMPIRICAL INTERPRETATION OF ANNULI CRITI-CAL MASS DATA. C. L. Schuske and G. H. Bidinger. Oct. 26, 1959. 26p. Contract AT(29-1)-1106. OTS.
    Simple empirical equations were found which relate the inside and outside diameters of annular vessels to the critical heights. From these equations, annuli of infinite length can be obtained. The interaction of 6-in. and 8-in. diameter cylinders in annular or circular arrays is discussed. (auth)

821   WAPD-P-661(Del.)
[Westinghouse Electric Corp. Atomic Power Div., Pittsburgh].
POWER DENSITIES AND FLUX DISTRIBUTIONS IN TWO SPECIAL SUBASSEMBLIES. P. G. Roll. May 16, 1955. Decl. with deletions Mar. 8, 1957. 11p. OTS.
    An attempt to estimate power densities in the neighborhood of the ORNL Stainless Steel subassembly and the Core One Boiling Removable Assembly (COBRA) is described. Calculations were based on a one-group treatment. A homogeneous distribution of materials was assumed in a central region representing the subassembly, as well as in a concentric, infinite region. Curves of relative power density vs. subassembly fuel loading were obtained. (W.D.M.)

822   Y-A2-104(Del.)
Carbide and Carbon Chemicals Co. Y-12 Plant, Oak Ridge, Tenn.
CRITICALITY REVIEW OF PROCESS FOR FABRICA-TION OF FUEL RODS. J. D. McLendon and J. W. Morfitt. Jan. 28, 1953. Decl. with deletions May 7, 1957. 6p. Contract W-7405-eng-26. OTS.
    Suggestions are given for maintaining nuclear safety during the fabrication of fuel rods. Included are brief comments on storage, handling, and area problems. (W.D.M.)

823
CRITICALITY PROBLEMS IN CHEMICAL PLANT DESIGN. G. R. Hall (Imperial Coll., London). Nuclear Power 4, No. 42, 97-9(1959) Oct.
    A review is given of criticality problems encountered in handling fissionable material, i. e., critical dimensions for mass and neutron leakage and reflection, control factors to reduce criticality hazard are discussed. (C.J.G.)

824
MINIMUM TOTAL MASS. J. Ernest Wilkins, Jr. (Nuclear Development Corp. of America, White Plains, N. Y.). Nuclear Sci. and Eng. 6, 229-32(1959) Sept.
    The problem of designing a reactor with minimum total mass is posed. This problem is related to that of designing a reactor with minimum critical mass. For a simple class of thermal slab reactors, the known solution of the minimum critical mass problem enables a complete solution of the minimum total mass problem. (auth)

825
AN EMPIRICAL CORRELATION OF THE EXPERI-MENTAL DATA ON HOMOGENEOUS, HIGHLY EN-RICHED, URANIUM AND URANIUM—HYDROGEN CRITICAL ASSEMBLIES. II. CHANGES IN PHYSICAL PROPERTIES. B. G. Owen and R. A. Gibson (United Kingdom Atomic Energy Authority, Caithness, Scotland). Reactor Technol. 1, 92-7(1959) Aug.
    An empirical correlation is presented which enables a constant B_0 to be determined in terms of the mass concentration of U^{235}, the atomic ratio H/U^{235}, and the excess multiplication ($k_\infty - 1$). This constant B_0 behaves similarly to the material buckling and from it can be determined the physical size of a hydrogeneous uranium critical assembly. (auth)

Elementary Particles

826   AECU-4411
Wisconsin. Univ., Madison <u>and</u> Maryland. Univ., College Park.
ON THE DECAY INTERACTION OF STRANGE PARTI-CLES. B. Sakita and S. Oneda. [1959]. 15p. OTS.
    It is proposed that the strength of the coupling constants is different for the strangeness non-conserving and strangeness conserving currents in the scheme of Fermi interactions of an ordinary charged current-current type. First, the consistency with experimental results is analyzed by introducing phenomenologically the direct Λ-n interaction. Then, the possibility of the derivation of this interaction as the effective interaction of the primary Fermi interactions is discussed. (auth)

827   CEA-925
France. Commissariat à l'Énergie Atomique, Paris.
CONTRIBUTION A L'ÉTUDE DE LA DIFFUSION MAGNÉTIQUE DES NEUTRONS. (Contribution to the Study of Magnetic Diffusion of Neutrons.) Pierre-Gilles De Gennes. 1959. 68p.
    Certain statistical aspects of a large collection of electronic spins coupled by exchange forces are examined. A system of this kind may be followed experimentally by elastic and inelastic diffusion of neutrons. At high temperatures, inelastic diffusion allows the microscopic aspect, reversible, and the microscopic aspect, irreversible, to be studied simultaneously and these two fields to be linked. At temperatures around the Curie point the average phenomenon is the appearance of a critical opalescence. At low temperatures, collective spin excitations can be observed. The spectrum of these excitations in metals is discussed. (auth)

828   NP-7966
Joint Inst. of Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy.
ELASTIC PROTON-PROTON SCATTERING AT 8.5 BEV. Chen Pu-in, V. B. Lubimov, P. K. Markov, M. G. Shafranova, and E. N. Tzyganov. 1959. 17p. (P-339).
    Elastic p-p scattering is investigated at 8.5 Bev by the emulsion method. The emulsion plates were exposed to the beam of incident protons perpendicular to the plane of emulsion. Sixty-six events of elastic scattering were found. The contribution of the scattering events on quasi-free protons and of other background events is 2%. The elastic scattering cross section was (8.4 ± 1.1) mb. The differential cross section up to 2.5° in the

center-of-mass system was obtained. Near 0° it was found to be greater than may be expected from the model of a purely absorbing proton. (auth)

829   NP-7967

Joint Inst. of Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics.
NUCLEON STRUCTURE. D. I. Blokhintsev, V. S. Barashenkov, and B. M. Barbashov. 1959. 54p. (P-317).

Methods for studying particle structure are discussed. The electromagnetic structure of the nucleon is considered. Critical remarks and analysis of Hofstadter's experiments are given. Effects of nucleon structure, theoretical attempts to interpret the electromagnetic structure of the central regions of nucleons, nuclear structure of nucleons, and the theory of the nucleon optical model are discussed. (W.D.M.)

830   NP-7970

Joint Inst. of Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems.
β-DECAY OF NEGATIVE PIONS. Yu. A. Budagov, S. Victor (Wiktor), V. P. Dzhelepov, P. F. Ermolov (Yermolov), and V. I. Moskalev. 1959. 7p. (P-359).

A diffusion cloud chamber operating in a magnetic field of 9000 gauss was used in a study of the $\pi^- \rightarrow e^- + \bar{\nu}$ decay. As a result of triple scanning of about 100,000 stereophotographs, 29 decays were found in which a secondary particle was deflected by the angle $\theta > 20°$. As a result of measurement, 26 events were identified as $\mu^- \rightarrow e^-$ decays and 3 events were attributed to $\pi^- \rightarrow e^- + \bar{\nu}$ decays. A value of $1.2 \pm 0.7 \times 10^{-4}$ was obtained for the ratio of $\pi^- \rightarrow e^- \bar{\nu} / \pi^- \rightarrow \mu^- + \bar{\nu}$. (W.D.M.)

831   NP-7971

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy.
ON A POSSIBILITY OF CONSTRUCTING A SYSTEM OF "ELEMENTARY" PARTICLES. I. V. Chuvilo. 1959. 9p. (P-358).

Attempts are being made to regard the known particles as certain structural formations, reducing thereby the number of "elementary" particles, as well as to restrict their possible interactions. Another possibility is proposed which does not appear to have been discussed previously. With the scheme under consideration there is a possibility of explaining a great number of the well-known experimental data on hyperon and K-meson production and interaction. (W.D.M.)

832   NP-7972

Joint Inst. of Nuclear Physics, Dubna, U.S.S.R. Lab. of Theoretical Physics.
A NOTE ON THE ELECTROMAGNETIC MASS OF K-MESON. Chou Kuang-Chao and V. [I.] Ogievetskii (Ogievetski). 1959. 5p. (P-352).

It is shown that there are no sufficient grounds to draw the conclusion that K^+ and K^0 do not form charge doublet and have different intrinsic parities. The mass difference can be explained inside the usual multiplet scheme of Gell-Mann-Nishijima, if the electromagnetic interaction of the K^0-meson is taken into consideration. (W.D.M.)

833   NP-7974

Joint Inst. of Nuclear Research Dubna, U.S.S.R. Lab. of Nuclear Problems.
STAR-DETECTOR FOR π^- MESONS. A. F. Dunaitzev, Yu. D. Prokoshkin, and Tang Syao-vay. 1959. 4p. (P-392).

In contrast to many other particles, stopping π^- mesons effectively produce stars with large energy release. These phenomena were utilized for selected detection of π meson. The star-detector of π mesons consists of a telescope of two scintillation counters set in coincidence. The first counter is an ordinary counter with 100% efficiency for passing particles. The second counter works at a comparatively low voltage supply, hence it detects the large light impulses only. A typical range curve for 160 Mev π^- mesons in carbon is given. (W.D.M.)

834   NP-7975

Tokyo Univ. Inst. for Nuclear Study and Kyoto Univ.
ELASTIC SCATTERING OF 14 Mev PROTONS BY DEUTERONS AND BY PROTONS. Seishi Kikuchi, Junpei Sanada, Shigeki Suwa, Izuo Hayashi, Keigo Nisimura, and Kiyoji Fukunaga. [1959]. 26p.

The differential cross sections for the elastic scattering of 13.93 Mev protons by deuterons were measured with accuracy varying from 1 to 3% at angles from 12 to 164° in the center-of-mass system. A shallow Coulomb-nuclear interference minimum near 17° was observed. The angular distribution is in good agreement with that of neutrons scattered by deuterons at 14 Mev, although the p-d cross sections seem systematically smaller than the n-d cross sections at backward angles. For forward angles, the experimental results contradict with the prediction of the existing theory. The small-angle p-d elastic scattering at 10.14 Mev was also investigated and a similar shallow Coulomb-nuclear interference was observed, in contrast with the theoretical curve of Christian and Gammel. The p-p scattering experiment of 14.16 Mev is also described. Measurements were made with accuracy of 1 to 2% for angles from 30 to 114° in the center-of-mass system. (auth)

835   NP-7985

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.
DETERMINATION OF THE MASS OF THE Λ^0 HYPERON. Report No. 106/VI. J Bogdanowicz, M. Danysz, A. Filipkowski, E. Marquit, E. Skrzypczak, A. Wróblewski, and J. Zakrzewski. Sept. 1959. 16p.

An analysis of 53 $\Lambda^0 \rightarrow p + \pi^-$ decays found in a stack of emulsion exposed to a beam of K^- mesons gives $Q_\Lambda = (37.58 \pm 0.18)$ Mev and $M_\Lambda = (1115.42 \pm 0.19)$ Mev. From an analysis of the results of other laboratories on the standard range of protons from the decay of Σ_p^+ hyperons at rest and the results obtained in the calibration of the emulsion used in the present work one obtains as the best estimate the value $R_{st} = (1678.6 \pm 3.2)$ μ, which corresponds to $M_{\Sigma^+} = (1189.43 \pm 0.31)$ Mev. (auth)

836   NP-7986

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.
A METHOD FOR DETERMINATION OF THE ENERGY SPECTRUM OF Λ^0 HYPERONS IN K^- INTERACTIONS WITH EMULSION NUCLEI. Report No. 107/VI. J. Bogdanowicz, A. Filipkowski, A. Krzywicki, E. Marquit, E. Skrzypczak, A. Wróblewski, and J. Zakrzewski. Sept. 1959. 8p.

Fifty-four cases of the decay $\Lambda^0 \rightarrow p + \pi^-$ were found in a recent study of the Λ^0 mass. The Λ^0 hyperons were produced by K^- interactions in emulsion. A method is outlined for obtaining the spectrum of the Λ^0 particles. No attempt was made to separate the Λ^0 particles ac-

cording to the process of their production, and there-
fore the energy spectrum represents a superposition of
Λ^0 particles from all the possible sources. (W.D.M.)

837   NYO-2232
Carnegie Inst. of Tech., Pittsburgh.
DISPERSION RELATIONS FOR PION SCATTERING.
Donald A. Geffen. July 1958. 23p. Contract AT(30-1)-
882. OTS.

The dispersion relations are used to predict the
values of the derivatives of the real part of the π^+ and
π^- forward scattering amplitudes, $\partial 0_+(0)/\partial k^2$, at zero
kinetic energy. The experimental value of $\partial D_+(0)/\partial k^2$
is fairly well known, and when compared with the pre-
dicted value, yields a determination of the coupling
constant, $f^2 = 0.104 \pm 0.014$. The predicted value for
$\partial D_-(0)/\partial k^2$ disagrees badly with experiment, especially
with an f^2 as large as 0.10. The dispersion relations
are modified by introducing an extra energy denomina-
tor in such a way as to contain, as the additional con-
stants, the derivatives $\partial D_\pm(0)/\partial k^2$. This enables one to
check the values of $\partial D_\pm(0)/\partial k^2$ obtained from the usual
dispersion relations as well as the assumption that
$\omega^{-2} T_\pm(\omega)$ vanishes at infinity. It is found that as long
as the agreement with experiment obtained for the π^+
relation is retained, no appreciable change in the
values of $\partial D_\pm(0)/\partial k^2$ is possible and that the high en-
ergy behavior of $T_\pm(\omega)$, usually assumed is correct.
The predicted value for $\partial D_-(0)/\partial k^2$ strongly suggests a
non-zero effective range for α_1 and a relatively large
α_{11}. (auth)

838   NYO-2233
Carnegie Inst. of Tech., Pittsburgh.
POLARIZATION OF THE RECOIL PROTON IN THE
SCATTERING OF 225 MEV π^- MESONS FROM PRO-
TONS. J. Ashkin, J. Kunze, and T. Romanowski. Nov.
1958. 92p. Contract AT(30-1)-882. OTS.

The polarization of the recoil proton is measured for
the elastic scattering of π^- mesons from protons, with
an incident π^- energy of 225 ± 10 Mev. Protons recoil-
ing at angles of 15 and 31° in the laboratory were se-
lected. The polarization analyser is a carbon plate $5/8''$
thick inside a counter controlled cloud chamber oper-
ating at a pressure of about one atmosphere. The
scattering events in the cloud chamber are photo-
graphed stereoscopically, and later reprojected through
the same optical system. The scattering angles and
track locations are determined directly by bringing the
two views of the track into coincidence on a reprojection
table. The measured polarizations are -0.13 ± 0.16 at
15° and $+0.36 \pm 0.29$ at 31°. The positive sign is for
polarization in the direction of $\vec{p}_{\pi \text{ incident}} \times \vec{p}_{p \text{ recoil}}$.
The results are used to make an experimental selection
between several sets of scattering phase shifts, which
represent the differential cross section data equally
well. The set favored is the Orear type of Fermi set,
in which the s-wave, isotopic spin $T = \frac{1}{2}$ phase con-
tinues to be positive and small, but approximately
linear with momentum. The Fermi set in which α_1
changes sign is definitely excluded. (auth)

839   NYO-2238
Carnegie Inst. of Tech., Pittsburgh.
MAGNETIC MOMENT OF THE DEUTERON. Hugh D.
Young. June 1959. 97p. Contract AT(30-1)-882.
OTS.

A contribution to the deuteron magnetic moment
which results from the altered expectation values of nu-
cleon core spins in the bound state is calculated. The
adiabatic approximation, in which the π meson clouds of
a static-nucleon model are assumed to follow the or-
bital motion of the sources, is used. The two-nucleon
states are expanded in Heitler-London states; the ex-
pectation value of the deuteron magnetic moment opera-
tor is related to single-nucleon matrix elements by
means of an expansion corresponding to exchange of
various numbers of mesons between the nucleons. The
single-nucleon matrix elements are evaluated using the
Chew-Low-Wick fixed-source theory. If an orbital
wave-function with a relatively large D-state probabil-
ity is used, the one-meson exchange terms give an in-
crease in the deuteron magnetic moment of about 1 per-
cent. The two-meson exchange terms are considerably
smaller than the one-meson exchange terms. (auth)

840   UCRL-8841
California. Univ., Berkeley. Lawrence Radiation Lab.
MULTIPLE MESON PRODUCTION IN NUCLEON-
ANTINUCLEON ANNIHILATIONS AND POLARIZATION
EFFECTS IN CASCADE SHOWERS (thesis). LeRoy
Franklin Cook, Jr. July 31, 1959. 71p. Contract W-
7405-eng-48. OTS.

Multiple Meson Production in Nucleon-Antinucleon
Annihilations: A two-parameter model is proposed for
treating complicated production problems in a rela-
tively simple way. It is assumed that the interaction
may be characterized by a range of interaction and by a
coupling strength. After the model is developed, it is
applied to the problem of pion production in N-$\bar{\text{N}}$ anni-
hilations. The two parameters are fixed by the experi-
mental data for the multiplicity and energy spectra. It
is found that all the data can be satisfied if one chooses
the radius of interaction to be one pion Compton wave-
length. Under certain restrictions the model reduces to
the Fermi model. Polarization Effects in Cascade
Showers: Using cross sections for bremsstrahlung and
pair production, which are not summed over the polari-
zations, the amount of polarization transmitted through
matter was calculated from an incident electron of 30
Mev by means of bremsstrahlung photons and the re-
sulting pair productions. (auth)

841
SCATTERING OF FAST ELECTRONS ON DEUTERONS.
H. Zingl (Universität, Graz). Acta Phys. Austriaca
12, 461-71(1959). (In German)

For the interaction of fast electrons with the deuteron,
the Vachaspati potential, which consists of a Coulomb
and a Yukawa term, was assumed. It contains two param-
eters, the weight factor of the Yukawa term and its
range which was determined by comparison with the
latest experimental data. The value for the weight
factor lies between 1 and 1.1, and that for the range is
approximately 0.3 Fermi. Two interpretations are given
for the results, a denial of quantum electrodynamics at
small distances or an expanded charge distribution of
the proton with negative point charge in the center and
a positive meson cloud. These possibilities are dis-
cussed. (tr-auth)

842
RADIATIVE MUON DECAY. S. G. Eckstein and R. H.
Pratt (Univ. of Chicago). Ann. Phys. (N. Y.) 8, 297-309
(1959) Oct.

Theoretical predictions for the radiative muon decay
process $\mu \to e + \nu + \bar{\nu} + \gamma$ are given in some detail.
The differential transition probability for polarized
muons is obtained, and from it are calculated the angu-
lar correlations of electron and photon, the photon

energy spectrum, and the branching ratio. The probability for internal conversion of the photon is estimated. The consequences of an intermediate vector boson are discussed. (auth)

843

THE EVALUATION OF BUBBLE CHAMBER PHOTO-GRAPHS AND THE EXPERIMENTAL RESULTS ON π MESON—PROTON SCATTERING. I. Derado, G. G. Lütjens, and N. Schmitz (Max-Planck-Institut für Physik and Astrophysik, Munich). Ann. Physik 4, 103-20(1959). (In German)

A numerical method for the analysis of elastic and inelastic scattering of 1.14-Bev negative pions on protons in bubble chamber photographs is described. Two criteria are used for the elimination of events with short tracks in which an analysis was difficult or impossible. For the avoidance of systematic errors in the results, a correction factor was calculated for each event measured. From the coordinates of multiple bubbles on each track and from the curvature of the secondary tracks in the magnetic field, the geometric and cinematic magnitudes of an event were calculated using a computer. It was then generally possible to decide whether an event was elastic or inelastic and—in the case it was inelastic with simple pion production—whether a π^+ or a π^0 was produced. In some inelastic events in which this last decision was not possible cinematically, the "δ beam" density was used for the decision. The total cross section for the various reactions of the π^--proton scattering were calculated from the measuring results. Moreover, the pulse distribution of the secondary particles of the reactions $\pi^- + p \rightarrow \pi^- + p + \pi^0$ and $\pi^- + p \rightarrow \pi^- + n + \pi^+$ were given in the center-of-mass system. (tr-auth)

844

ON THE SCATTERING OF ANTIPROTONS IN NUCLEAR MATTER. A. G. Ekspong (Inst. of Physics, Uppsala). Arkiv Fysik 16, 129-36(1959).

A statistical model calculation of the effective scattering cross section per nucleon in nuclei is presented. Because of the Pauli exclusion principle, the scattering cross section is reduced to $\sigma_{eff.} = f \cdot \sigma_{sc.}$; $\sigma_{sc.}$ being the free antiproton-nucleon cross section. The anisotropic form of the scattering cross section is taken into account. Formulas are given for evaluating f, the reduction factor. At 190 Mev kinetic energy (inside the nucleus) the computed value of the reduction factor is 0.62 for an assumed total cross section of 150 mb on free nucleons. (auth)

845

INELASTIC NUCLEON-DEUTERON SCATTERING. [PART] I. THE TRANSITION MATRIX IN THE IMPULSE APPROXIMATION FOR GENERAL TWO-BODY INTERACTIONS. Tore Berggren and Stig O. Lundqvist (Univ. of Uppsala). Arkiv Fysik 16, 153-68(1959).

Expressions for the transition matrix elements are derived in the impulse approximation, assuming general two-body interactions. (auth)

846

INELASTIC NUCLEON-DEUTERON SCATTERING. II. PHYSICAL DISCUSSION OF THE IMPULSE APPROXIMATION WITH THE DOUBLE SCATTERING TERMS INCLUDED. Tore Berggren (Univ. of Uppsala). Arkiv Fysik 16, 169-80(1959).

Inelastic nucleon-deuteron scattering is treated in such a manner that all physical processes that may occur in the scattering are included in the transition operator, including the double scattering terms in the impulse approximation. An estimate of the importance of the double scattering terms is made, and it is found that double scattering may be important at all energies, depending on the magnitude of final, rather than initial, relative momenta. (auth)

847

ON THE SYSTEMATICS OF ELEMENTARY PARTICLES. O. Klein (Univ. of Stockholm). Arkiv Fysik 16, 191-6(1959).

Proposed schemes of spin assignment for baryons, leptons, and mesons which follow the natural generalization of the isotopic spin scheme of Kemmer are discussed. (C.J.G.)

848

MOMENTUM DISTRIBUTION OF ANNIHILATING ELECTRON-POSITRON PAIRS IN LiF. R. H. March and A. T. Stewart (Dalhousie Univ., Halifax, N. S.) Can. J. Phys. 37, 1076-8(1959) Sept.

The momentum distribution of electron-positron pairs annihilating in LiF was determined. The results were in good agreement with those of Long and DeBenedetti. (C.J.G.)

849

CONSERVATIVE QUANTITIES OF PARTICLES OF SPIN $\frac{1}{2}$ AND ZERO MASS. Judith Winogradzki (Institut Henri Poincaré, Paris). Compt. rend. 249, 1087-9(1959) Sept. 28. (In French)

The Dirac equation $m\Psi + \gamma_k \Psi_k = 0$ can be deduced from four lagrangians if m = 0, two lagrangians if m is real or imaginary, and one lagrangian if m is complex. Knowledge of these lagrangians leads to new conservation laws. (tr-auth)

850

A REMARK ON PION DECAY. J. M. Jauch and Y. Yamaguchi (CERN, Geneva). Helv. Phys. Acta 32, 251-6(1959). (In German)

The hypothesis proposed by Feynmann and Gell-Mann for the clarification of the relative coupling strength of V and A interaction in beta decay leads to a weak coupling of the π meson with leptons so that a positive π meson decays by the scheme $\pi^+ \rightarrow \pi^0 + e^+ + \nu$. The total transition probability for the reaction is derived, and the average life is evaluated as 2.4 sec. For the reaction $K^0 \rightarrow K^+ + e^- + \bar{\nu}$ an average life of 34 sec is obtained for a mass difference of 6.1 m. (J.S.R.)

851

MESON TRANSFORMATION AND SYMMETRIES OF ELEMENTARY INTERACTIONS. H. Ruegg (Université, Geneva). Helv. Phys. Acta 32, 256-8(1959). (In French)

The group of meson transformations described previously by Stueckelberg and Petermann (Helv. Phys. Acta 26, 506(1953)) are generalized for interactions of nucleons with charged mesons. (J.S.R.)

852

SCATTERING AND POLARIZATION EFFECTS OF FAST NEUTRONS ON DEUTERONS. H.-J. Gerber, M. Brüllmann, D. Meier, and P. Scherrer (Physikalisches Institut der ETH, Zurich). Helv. Phys. Acta 32, 270-2(1959). (In German)

The differential cross section and the polarization for the elastic scattering of 3.27-Mev neutrons on deuterons were measured and compared with theoretical results obtained by previous investigators. (J.S.R.)

853

CROSS SECTION FOR THE DIRECT CREATION OF ELECTRON PAIRS BY 640-MEV ELECTRONS. C. Piron, M. Gailloud, and M. Biasutti (Laboratoire de Recherches Nucléaires, Lausanne, Switzerland). Helv. Phys. Acta 32, 274-5(1959). (In French)

Nuclear emulsions were exposed to a beam of electrons, the emulsions were developed, and the electron tracks were followed to a depth of 1 cm to determine the number of tridents. The average energy of the primary electrons was 640 Mev with a consideration of the energy loss in 1 cm. A total number of 111 tridents caused by the direct production of an electron pair in the field of the nucleus was detected. The experimental cross section for the pair production was $(9.3 \pm 1.1) \times 10^{-3}$ cm^{-1}. The possible reasons for the deviation from the theoretical value of 6.8×10^{-3} cm^{-1} are given. (J.S.R.)

854

POLARIZATION OF RADIATION FROM THREE-PHOTON DECAY OF POSITRONIUM. V. P. Shmelev. Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 1, 15-24 (1959).

Orthopositronium decays with a lifetime of 1.4×10^{-7} sec into three photons; parapositronium decays with a lifetime of 1.25×10^{-10} sec into two photons. In each case, since the photons arise from the mutual annihilation of the electron-pair constituting the original positronium atom, the laws of energy and momentum conservation imply certain relations between the initial positronium energy state and the energy, momentum, and polarization of the resultant photons. After a brief treatment of two-photon decay, leading to an approximate non-relativistic transition probability for this case, the fully relativistic treatment of three-photon decay is presented. (TCO)

855

$K^0 - K^+$ MASS EXCESS. Riazuddin (Imperial Coll. of Science and Tech., London). Nuclear Phys. 12, 342-8 (1959) Aug. (1).

An explanation is given of the recently measured $K^0 - K^+$ mass difference in terms of the self-energies of the K-mesons due to K-baryon interaction. Cases considered include one in which $K^0 - K^+$ relative parity is assumed to be odd, and a non-electromagnetic mass split arises, and another in which $K^0 - K^+$ relative parity is taken to be even and the doublet nature of K is maintained. The mass difference for this case is calculated via the renormalization of K-baryon coupling constants due to electromagnetic field. It is shown that in either case K^0 may be heavier than K^+. Both cases favor pseudoscalar K^+ with respect to ΛN and ΣN systems. But while the case with pseudoscalar K^+ favors even $\Xi - N$ relative parity, the opposite holds for the other case, and for the first case, scalar K^+ together with odd $\Xi - N$ relative parity is also possible. (auth)

856

PHOTO PRODUCTION OF PION PAIRS BY A NUCLEON. S. K. Srinivasan and K. Venkatesan (Univ. of Madras). Nuclear Phys. 12, 418-25(1959) Aug. (1).

Double photo production of pions by nucleons is examined on the basis of the fixed extended source theory of Chew and Low. A linear integral equation for the matrix element is derived using the Tamm-Dancoff approximation. Using the solution of Chew and Low for single production, an expression for the cross section

of the process is obtained as a first approximation. The total cross section compares favorably with the experimental results of Sellen, Cocconi and Hart. (auth)

857

THE POLARIZATION OF DEUTERONS AND PARTICLES OF ARBITRARY SPIN II. L. J. B. Goldfarb and J. R. Rook (Univ. of Manchester, Eng.). Nuclear Phys. 12, 494-509(1959) Aug. (2).

General formulas are given for the polarization of charged particles of arbitrary spin emitted in an elastic scattering process in the neighborhood of an isolated resonance, taking into account the specific Coulomb and potential contributions. These formulas also apply to the angular distributions associated with incoming polarized particles. The results are expressed in terms of the channel-spin and total angular-momentum representations. Application is made to the elastic scattering of deuterons by He^4 at 1.069 Mev. Previous estimates of the polarization based on consideration of only resonance scattering require modification, particularly at low angles. Large values are found for the vector polarization which arise solely from the interference between resonance and non-resonance scattering. (auth)

858

K^+-MESON-NUCLEON SCATTERING AND K^+-Y RELATIVE PARITY. L. K. Pandit and S. N. Biswas (Tata Inst. of Fundamental Research, Bombay). Nuclear Phys. 12, 521-6(1959) Aug. (2).

A covariant integral equation in the ladder approximation was set up for the Feynman amplitude describing the K^+-nucleon scattering through a strong direct K-Y-N interaction. The two possibilities of the relative K-Y parities were considered, it being assumed that both K^0 and K^+ have identical parity. The equation was solved by the Fredholm method employing the prescription of McCarthy and Green to obtain a divergence-free solution. The calculations favor even relative K-Y parity. For best fit with (K^+-p) scattering experiments, the coupling constants required are $G_{NK\Lambda} = \sqrt{3G_{NK\Sigma}}$, $G^2_{NK\Sigma}/4\pi = 0.5$. (auth)

859

REMARKS ON THE DECAY INTERACTIONS IN THE K_{e3} PROCESS. Minoru Yonezawa (Hiroshima Univ.). Nuclear Phys. 12, 589-95(1959) Sept. (1).

Two points are discussed with respect to the decay interaction of K_{e3}. The possibility of Konopinski-Uhlenbeck type interaction (rather than Fermi type interaction) is examined. It is shown that there exists a certain equivalence theorem between Fermi type interaction and Konopinski-Uhlenbeck type interaction and that owing to this theorem it is impossible to discriminate between them. Experimental data concerning the secondary electron energy spectrum in K^+_{e3} are analyzed from the standpoint of primary weak Fermi interaction in order to discuss the type of decay interaction. It is suggested that the existence of scalar and tensor interactions is necessary to explain the experimental K^+_{e3} electron energy spectrum, while the vector interaction gives a fit with χ^2-probability $\lesssim 0.07$. (auth)

860

ELASTIC NEUTRON-DEUTERON SCATTERING. Richard Blankenbecler, Marvin L. Goldberger, and Francis R. Halpern (Princeton Univ., N. J.). Nuclear Phys. 12, 629-46(1959) Sept. (1).

The process of elastic neutron-deuteron scattering is discussed from the standpoint of dispersion theory.

Aside from the appearance of anomalous thresholds, there seems to be no difficulties in principle, although no derivation of the relations is attempted. Certain features of the process, such as the pick-up peak in the backward direction, appear quite neatly and the general occurrence of such phenomona is discussed. The theory is developed for the general case, but the only application is to forward scattering at low energies where phase shift analyses are available. The agreement with experiment is quite good. (auth)

861

K$^-$-MESON PARITY FROM THE REACTION K$^-$ + d → Λ^0 + p + π$^-$. R. Stroffolini and G. Varcaccio (Scuola di Perfezionamento in Fisica Teorica e Nucleare, Naples). Nuovo cimento (10) 13, 249-56(1959) July 16.

The possibility of determining the product parity of K$^-$ and Λ^0 relative to the nucleon from the reaction K$^-$ + d → Λ^0 + p + π$^-$ is discussed. The considerable difference between triplet and singlet Λ^0-nucleon interactions allows prediction of the spectrum of the Λ^0-p relative energy, strongly depending on the assumed K$^-$-Λ^0 relative parity. (auth)

862

DECAY RATE AND SPECTRUM OF ELECTRONS FROM μ$^-$-MESONS OF THE K-SHELL. L. Tenaglia (Università, Bari, Italy). Nuovo cimento (10) 13, 284-91(1959) July 16.

The decay rate of a μ$^-$ meson from the K-shell of a light nucleus is evaluated as a function of the momentum of the produced electron and of the atomic number, taking into account the main electrostatic corrections on the usual, plane wave eigenfunctions of the electron, by a Born-like approximation. Such corrections change appreciably the decay rate and the shape of the spectrum of the emitted electrons. (auth)

863

K$^-$-p SCATTERING AT LOW ENERGY. S. Minami (Osaka City Univ.). Nuovo cimento (10) 13, 354-62 (1959) July 16.

The experimental results for K$^-$-p collisions obtained by Glasser are analyzed in a phenomenological way. One conclusion is that the experimental results for K$^-$-p scattering at low energy can be explained by taking account of the effects of absorption, even if the values of phase shifts are not so large. The phenomenological analysis worked out by Ascoli is discussed. (auth)

864

SCATTERING OF Λ^0 HYPERONS BY NUCLEONS AT INTERMEDIATE ENERGIES. J. S. Kovacs and D. B. Lichtenberg (Michigan State Univ., East Lansing). Nuovo cimento (10) 13, 371-5(1959) July 16.

A calculation is made of the Λ^0-nucleon scattering cross section at 75 and 150 Mev laboratory energies, based on a phenomenological central potential with a hard core to describe the Λ^0-nucleon interaction. The potential is chosen so as to give agreement with hyperfragment data and at the same time to have reasonable properties from a meson-theoretical viewpoint. With this potential the Λ^0-nucleon cross section is calculated numerically, assuming that scattering occurs only in states with orbital angular momentum ≤2. The result is that the Λ^0-nucleon cross section is approximately constant in the energy range considered. The variation is from 26 mb at 75 Mev to 21 mb at 150 Mev without a spin-orbit force, and from 34 mb at 75 Mev to 32 mb at 150 Mev with a spin-orbit force. These results are

consistent with the previous preliminary measurements. (auth)

865

INTERACTION OF ANTILAMBDA HYPERONS WITH NUCLEONS AT INTERMEDIATE ENERGIES. J. S. Kovacs and D. B. Lichtenberg (Michigan State Univ., East Lansing). Nuovo cimento (10) 13, 376-80(1959) July 16.

Cross sections for the scattering and annihilation of antihyperons by nucleons are calculated at 75 and 150 Mev laboratory energies. The model of the anti-$\bar{\Lambda}^0$-nucleon interaction is an attractive potential at large interparticle separations and a black absorptive hole at separations less than ~0.4 fermis. The cross-sections are obtained both with and without a spin-orbit term in the potential. The outer part of the potential is taken to be the same as the outer part of the Λ^0-nucleon potential required to fit the binding energies of the Λ^0 in hyperfragments. This form for the outer region follows from the assumption that this part of the potential arises from the exchange of two pions. The results indicate that about one anti-$\bar{\Lambda}^0$ in 50 will interact with a nucleon in a hydrogen bubble chamber at 150 Mev, the others decaying in flight. There are as yet no experimental data with which to compare the calculated cross-sections. (auth)

866

THE INELASTIC SCATTERING OF ELEMENTARY PARTICLES. P. T. Matthews and A. Salam (Imperial Coll., London). Nuovo cimento (10) 13, 381-93(1959) July 16.

The requirements of unitarity and causality are used to obtain a convenient set of real constant parameters for the phenomenological description of low energy elementary particle scattering . It is assumed that an arbitrary number of channels are open but that there are just two particles in each channel. This discussion is a direct generalization of effective range theory. From this point of view, the Breit-Wigner and Chew-Low formulas are derived. Unitarity is then used to relate the parameters, below threshold for one or more of the channels, to the larger number of parameters required when all channels are open. These considerations are applied to the K$^-$-nucleon system. (auth)

867

POSSIBLE TEST OF CONSERVATION OF PARITY IN PRODUCTION OF K-MESONS AND HYPERONS. V. G. Solov'ev (Soloviev) (Joint Inst. for Nuclear Research, Dubna, USSR). Nuovo cimento (10) 13, 442-3(1959) July 16.

The reaction π + N → Y + K and subsequent decay Y → N + π (Y is Λ or Σ hyperon) is studied to determine a test of parity conservation in K-meson and hyperon production. By assuming that parity was not conserved, a representation of the hyperon polarization vector was developed. From this vector rotation, asymmetries were derived which could be used to show when parity is not conserved. (C.J.G.)

868

ON THE DIRECT PRODUCTION OF AN ELECTRON PAIR BY A HIGH ENERGY α-PARTICLE. K. Lanius and H. W. Meier (Deutsche Akademie der Wissenschaften, Berlin and Kernphysikalisches Institut, Zeuthen, E. Ger.). Nuovo cimento (10) 13, 444-5(1959) July 16.

A track of a primary α-particle from a jet 0 + 14α in

an I-stack was 12.49 cm long (from edge of stack to jet). At 10.82 cm an interaction occurred in which two minimum ionizing particles were produced. The energies of these two particles were determined by relative scattering measurements. It is concluded through probability calculations that direct production of an electron pair by the high energy in the electric field of a nucleon of the emulsion took place. (C.J.G.)

869

ON THE POSSIBILITY OF ENERGY DEPENDING SYMMETRY PROPERTIES. B. Ferretti (Università, Bologna). Nuovo cimento (10) 13, 456-7(1959) July 16.

With some natural restrictions, the possibility of ruling out some energy dependent symmetry properties is pointed out. Discussion is given on a hypothesis which states that if there are states in which the symmetry property is valid, it is always possible to perturb the symmetry property in this state with a very small but finite external interaction represented by an operator which commutes with the operator of the supposed symmetry without destroying the symmetry property. (C.J.G.)

870

ON THE POSSIBLE EXISTENCE OF HYPERFRAGMENTS WITH MASS NUMBER A = 6. B. Barsella and S. Rosati (Università, Pisa, Italy and Istituto Nazionale di Fisica Nucleare, Pisa, Italy). Nuovo cimento (10) 13, 458-9(1959) July 16.

Recently observed hyperfragment decay can be most simply interpreted by assuming the existence of Λ-hyperfragments with mass number A = 6. Calculations were made of the binding energy of the neutron in He^6 to determine if the existence of such hypernuclei agrees with present knowledge regarding forces acting between hyperons and nucleons. (C.J.G.)

871

ON THE LORENTZ-INVARIANT APPROXIMATION METHOD IN GENERAL RELATIVITY. III. THE EINSTEIN-MAXWELL FIELD. R. P. Kerr (King's Coll., London). Nuovo cimento (10) 13, 673-89(1959) Aug. 16.

It is shown that it is possible to set up a consistent Lorentz-invariant approximation procedure without it being necessary to expand the particle parameters, such as the mass and the charge. By using an invariant Green's function, an integral expression was calculated for the field. This is a solution of the Einstein-Maxwell field equations, provided that the differential equations of motion, mass, charge, and spin are satisfied for each particle. The result does not depend on the degree of complexity of the first order solution. It is shown that the electromagnetic self forces which appear in the second approximation are significant, whereas it is necessary to go to the fourth approximation before it can be shown that the corresponding gravitational self forces are real and do not disappear in the higher approximations. It is also shown that the mass is conserved to the second approximation, but that the charge is not. (auth)

872

THE INTERACTION AND DECAY OF K^- MESONS IN PHOTOGRAPHIC EMULSION. PART I. GENERAL CHARACTERISTICS OF K^--INTERACTIONS AND ANALYSIS OF EVENTS IN WHICH A CHARGED π-MESON IS EMITTED. B. Bhowmik, D. Evans, D. Falla, et al. (H. H. Wills Physical Lab., Bristol, Eng.). Nuovo cimento (10) 13, 690-729(1959) Aug. 16.

A total of 3,480 K^--mesons were observed. Of these, 445 interact in flight, at a mean energy of 40 Mev and only their general characteristics were studied. Little difference was observed between the number of unstable charged particles ($\Sigma^\pm$-hyperons and $\pi^\pm$-mesons) in these interactions and those in the 3,035 interactions at rest. The 3,035 K^--interactions at rest were studied in detail. The results on those interactions in which π-mesons are emitted are given. An estimate of the Σ-hyperon nuclear potential is based on the energy spectrum of π-mesons emitted in the K^--interactions in which the only charged particles emitted are a π-meson and a Σ-hyperon. A detailed examination of the angular distribution of 2-pronged events, and of the sign ratio of the π-mesons, the prong distribution and energy release in all events led to an estimate of the probabilities of absorption of positive and negative Σ-hyperons in the parent nucleus, and to a partition of the events between the various primary reactions. (auth)

873

STRUCTURE SINGULARITIES OF ELECTROMAGNETIC FORM FACTORS. R. Oehme (Univ. of Chicago). Nuovo cimento (10) 13, 778-89(1959) Aug. 16.

In local field theories the form factors of particles can have singularities which are characteristic for the structure of these particles as composite systems. These structure singularities are studied with the help of examples from perturbation theory. Their mathematical properties are described for real and complex values of the mass variable, and their physical implications are discussed. (auth)

874

ELECTRON-POSITRON ELASTIC SCATTERING FROM EXTENDED NUCLEI. P. Budini and G. Furlan (Università, Trieste, Italy and Istituto Nazionale di Fisica Nucleare, Trieste, Italy). Nuovo cimento (10) 13, 790-801(1959) Aug. 16.

Second order Born approximation of electron-positron elastic potential scattering from extended nuclei is calculated, and a general formula is given for any charge distribution. The dependence of $(\sigma_- - \sigma_+)/\sigma_-$ from particular charge distributions is analyzed and discussed. (auth)

875

ANALYSIS OF THE CHARGE EXCHANGE REACTION $K^+ + p \rightarrow K^0 + n$. C. Ceolin, N. Dallaporta, L. Guerriero, I. Laboragine, G. A. Salandin, and L. Taffara (Università, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo cimento (10) 13, 818-38 (1959) Aug. 16.

A detailed analysis of the data concerning the reaction $K^+ + p \rightarrow K^0 + n$ was studied to better understand the energy associated with the total cross-section and the angular distribution of the differential cross section. It is found that the best fit for the data, corrected for all effects in nuclei, indicate that the total charge-exchange cross-section increases with about the third power of the c.m. momentum. An analysis of the secondary prongs of the K-nucleus events leading to charge-exchange gives indications that the differential cross section is peaked backward in the c.m. system. These data do not seem to fit with the theoretical formula based on a K-K-π-interaction. Different theoretical interpretations are discussed in an attempt to explain the proceding behavior of the charge-exchange reaction. (auth)

876

CONCERNING THE EXISTENCE OF A Σ^-n COM-
POUND. E. Gandolfi, J. Heughebaert, and E. Quercigh
(Istituto Nazionale di Fisica Nucleare, Milan). Nuovo
cimento (10) 13, 864–67(1959) Aug. 16.

The interactions at rest of K^--mesons with two or
more nucleons were examined in a stack of K-5 emul-
sions each 600 μm thick. Of 35Σ tracks, two showed
an anomalous variation of ionization with path length.
One particle of charge 1 is shown to have a mass
approximately twice that of the proton (weighted mean
of 3817 ± 167 m_e) which decays in flight with emission
of a 70-Mev π^-. Its presence in a K^- interaction leads
to an attribution of strangeness–1 and baryonic number
2. The time of flight was 2×10^{-10} sec. Using the
scheme of known particles, the most reasonable inter-
pretation of the event is that it is a $(\Sigma^- n)$ hyperfragment.
(C.J.G.)

877

THE INTERACTIONS OF π^--MESONS WITH COMPLEX
NUCLEI IN THE ENERGY RANGE (100–800) Mev. I.
THE INTERACTION LENGTHS AND ELASTIC SCAT-
TERING OF 88 Mev π^--MESONS IN G5 EMULSION.
J. E. Allen, A. J. Apostolakis, Y. J. Lee, J. V. Major,
and E. Perez Ferreira (Univ. of Durham, Eng.). Phil.
Mag. (8) 4, 858–67(1959) July.

A block of emulsion was exposed to the 96 Mev π^--
meson beam of the Liverpool synchrotron and 92.5 m
of track were scanned in the region where the mean
energy is 88 Mev. After correction for beam contami-
nation, the interaction lengths for the production of
inelastic events and for elastic scatters with projected
angle of scatter $\geq 8°$ are (20.4 ± 1.1) cm and (32.3 ± 2.1)
cm, respectively. The geometrical interaction length
is 29.3 cm. With the optical model of the nucleus, the
absorption coefficient is found to be K = (4.0) 10^{12}cm^{-1},
and the change in wave number is given by
$k_1 = -(1.86 \pm 0.20)10^{12}$cm^{-1}. This absorption coefficient
corresponds to a mean free path in nuclear matter
$\lambda_n = (2.5)10^{-13}$cm, to an imaginary component of poten-
tial $V_i = -(32)$ Mev, and with the value of the change
in wave number to a real potential $V_r = -(28 \pm 3)$Mev.
(auth)

878

PHENOMENOLOGICAL ANALYSIS OF HYPERON DE-
CAY. S. A. Bludman (Univ. of California, Berkeley).
Phys. Rev. 115, 468–71(1959) July 15.

The $\Delta I = \frac{1}{2}$ rule is incorporated into a previously
discussed universal weak Yukawa interaction by assum-
ing the simplest relation between chirality and charge op-
erators. Expressing the $\Delta I = \frac{1}{2}$ rule by forming the N
and Ξ isospinors into an isovector B and an isoscalar
B_0, it is assumed B occurs (as in β decay) with $g\gamma_\mu \frac{1}{2}$
$(1 + r\gamma_5)$ and B_0 (which has no β–decay counterpart) with
$g\gamma_\mu \frac{1}{2}(1 - r\gamma_5)$. Here g is the constant previously fitted to
the π decay rate, and r the ratio of Gamow–Teller and
Fermi coupling constants. Depending on the sign taken
between the B and B_0 interaction terms, Σ decays into
$n + \pi^+$ in pure S and into $n + \pi^-$ in pure P channels, or
vice versa. In either case, $\Sigma^+ \rightarrow p + \pi^0$ involves maxi-
mal S-P interference and $\alpha^0 = 0.98$. Decay into I = $\frac{1}{2}$
proceeds via $\gamma_\mu(\frac{1}{2} + \frac{3}{2} r\gamma_5)$ or $\gamma_\mu(\frac{3}{2} + \frac{1}{2}r\gamma_5)$, depend-
ing on whether Σ^- decay is pure S or pure P. The sec-
ond case, but not the first, leads to a Λ-αecay rate in
agreement with experiment. In this case $\alpha_\Lambda = 0.54$, and
in Ξ^- decay, $\alpha_\Xi = 0.64$ and the calculated decay rate is
2.4×10^{-10} sec^{-1}. (auth)

879

DYNAMICS OF A SYSTEM OF SPIN 1 PARTICLES.
K. T. Mahanthappa (Harvard Univ., Cambridge, Mass.)
and P. M. Mathews and Jayaseetha Rau (Brandeis Univ.,
Waltham, Mass.). Phys. Rev. 115, 478–81(1959) July
15.

The time variation of the dipole and quadrupole
polarizations of a system of spin 1 particles is dis-
cussed. The case of axially symmetric external fields
is treated in detail and it is shown that this furnishes
a canonical representation for the polarization dynam-
ics. Elementary techniques are used to obtain an enu-
meration of the constants of motion and a geometric
representation of the time dependence of the multipole
polarizations. (auth)

880

INTERFERENCE EFFECTS IN LEPTONIC DECAYS.
Steven Weinberg (Columbia Univ., New York). Phys.
Rev. 115, 481–4(1959) July 15.

It is proven that in any leptonic decay experiment in
which the lepton masses and charges may be neglected,
and in which no pseudoscalar correlations are meas-
ured, all V·A interference terms will be antisymmetric
under exchange of the two leptons, while the pure V and
A terms will be symmetric. If the experiment measures
a pseudoscalar correlation, these conclusions are re-
versed. Even if the lepton masses cannot be ignored
(e.g., for $\Lambda^0 \rightarrow \mu^- + \nu + p$, or low–energy β decay) it is
still true that no V·A interference may appear when
scalars are measured, and only V·A interference may
contribute when pseudoscalars are measured, providing
that the lepton spins and momenta are not directly ob-
served. Thus experiments can be devised that involve
no interference effects, or only interference effects.
This theorem holds independently of the strangeness
change, spin change, energy transfer, or of any particu-
lar assumptions about the form of the V and A currents.
It proves most useful when it is difficult or tedious to
calculate transition rates directly. Applications are
discussed, including possible tests of the Feynman-
Gell-Mann theory in nonunique forbidden β decay, of the
nature of the leptonic Λ^0 and K^0 decay interaction, and
of the charge symmetry properties of weak interactions.
(auth)

881

CONVERSION ELECTRON ANGULAR CORRELATIONS:
GENERAL K-SHELL FORMULATION AND THRESH-
OLD LIMIT. Robert C. Young (Rice Inst., Houston,
Tex.). Phys. Rev. 115, 577–85(1959) Aug. 1.

A general treatment of polarization-angular correla-
tions involving conversion electrons is presented.
Formulas are given for the b_ν coefficients for all types
of polarization of the conversion electron, electric and
magnetic multipoles, and arbitrary complexity ν. It is
shown that only three coefficients are needed to char-
acterize completely correlations of conversion elec-
trons from the K shell, for a given type of transition.
Curves are given of the threshold values for these co-
efficients for L = 1–5, electric and magnetic, versus
atomic number. The relativistic Coulomb functions
(point nucleus, no screening) are presented, along with
a number of properties and expansions, in a convenient
and consistent notation. Several identities and relations
involving the vector addition coefficients are included.
(auth)

882

MOST PROBABLE ENERGY LOSS OF FAST ELEC-

TRONS. H. E. Hall, A. O. Hanson, and D. Jamnik (Univ. of Illinois, Urbana). Phys. Rev. 115, 633-5 (1959) Aug. 1.

The most probable energy losses of electrons of 3.4, 7.2, 11.2, 15.6, and 19.4 Mev were measured for Al, Cu, Ag, Ta, Au, and U samples of about 1 g/cm². The measurements agree with available calculations and remove the previous discrepancy for gold. (auth)

883

PRODUCTION OF Σ^+ HYPERONS BY 990-Mev POSITIVE PIONS IN LIQUID HYDROGEN. A. R. Erwin, Jr., and J. K. Kopp (Brookhaven National Lab., Upton, N. Y. and Harvard Univ., Cambridge, Mass.) and A. M. Shapiro (Brown Univ., Providence and Harvard Univ., Cambridge, Mass.). Phys. Rev. 115, 669-72(1959) Aug. 1.

The production and subsequent decay of six Σ^+ hyperons were observed in the central region of a hydrogen bubble chamber exposed to π^+ mesons of kinetic energy 990 ± 30 Mev at the Cosmotron. The corresponding total production cross section, corrected for scanning inefficiencies, is 0.16 mb. This value, combined with weighted averages of Σ^0 and Σ^- production cross sections in hydrogen obtained by Brookhaven, Columbia, and Berkeley groups, is used to compute the three triangular inequalities imposed by charge independence. (auth)

884

RECOIL MOMENTUM DISTRIBUTION IN ELECTRON PAIR PRODUCTION. K. S. Suh and H. A. Bethe (Cornell Univ., Ithaca, N. Y.). Phys. Rev. 115, 672-7(1959) Aug. 1.

Electron pair production by a very energetic photon in the field of a particle of arbitrary mass (in particular in the fields of an electron and a nucleus) was studied following the work of Borsellino. The distribution of recoil momenta q was calculated for q of order of the electron mass and it is shown that the recoil distribution is independent of the mass of the recoil particle if appropriate variables are used. It is also explicitly shown that the mass of the recoil particle does not make any difference in the recoil distribution for very small q (of order q_{min}). The total cross section must therefore be independent of the mass of the recoil particle in the high-energy limit, as previously stated by Borsellino. The Wheeler-Lamb result for pair production in the field of a bound electron was also justified. The results also describe the electromagnetic production of any fermion pair if certain restrictions are satisfied. (auth)

885

ELECTRON PAIR PRODUCTION IN THE FIELD OF THE PROTON AND IN THE FIELD OF THE ELECTRON BY PHOTONS OF ENERGY FROM 10 Mev TO 1 Bev. E. L. Hart, G. Cocconi, V. T. Cocconi, and J. M. Sellen (Cornell Univ., Ithaca, N. Y.). Phys. Rev. 115, 678-86(1959) Aug. 1.

A 24-in. diffusion cloud chamber filled with hydrogen and located in a magnetic field was placed in the hardened bremsstrahlung beam of the Cornell synchrotron to study electron pair production in the proton field (P.F. pairs) and in the electron field (E.F. pairs). The E.F. pairs could be detected with an average efficiency of ~85% and are about as abundant as the P.F. pairs. A total of 3065 pairs produced by photons with energy from 10 to 1040 Mev were analyzed. The recoil momentum distribution of the E.F. pairs was in good

agreement with the distribution predicted by Suh and Bethe. The cross section for E.F. pairs was consistent with that calculated by Wheeler and Lamb. The distribution of the opening angle of P.F. and E.F. pairs was in general agreement with Borsellino's calculations, at large angles. However, the peak appears at smaller angles than predicted. (auth)

886

RADIATIVE MUON CAPTURE. Jeremy Bernstein (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev. 115, 694-705(1959) Aug. 1.

The theory of radiative muon capture is developed. The discussion includes both parity conserving and nonconserving effects. The Gell-Mann weak magnetic term and the induced pseudoscalar are included, along with comparable relativistic effects in the nucleons. The theory is applied to light nuclei and especially to the radiative Godfrey reaction $\mu^- + C^{12} \rightarrow \nu + \gamma + B^{12}$. An experiment to detect the induced pseudoscalar directly is proposed. (auth)

887

PARITIES OF K-HYPERON PAIRS. Richard H. Capps (Cornell Univ., Ithaca, N. Y.). Phys. Rev. 115, 736-41 (1959) Aug. 1.

The possibility of determining the relative parity of K-hyperon pairs by measurements of reactions of the type π(or K) + p $\rightarrow$ K(or π) + hyperon is investigated. If the protons are polarized in a direction perpendicular to the incident meson beam, it is shown that measurements of the correlation between the proton spin direction and the direction of the meson from the hyperon decay are capable of determining the parity unambiguously, provided that the K spin is zero and the hyperon spin is known. Several alternate parity-determining experiments that do not require polarized proton targets are discussed; these experiments are all quite difficult, however. (auth)

888

SOME CONSEQUENCES OF SYMMETRIES OF THE STRONG INTERACTIONS. G. Feinberg and R. E. Behrends (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 115, 745-9(1959) Aug. 1.

The consequences for the electromagnetic interactions of strange particles of some proposed symmetries of the strong interactions are discussed. A minimal electromagnetic coupling is assumed. It is shown that if the interactions with both π and K mesons of the nucleon and cascade particle are identical, if one neglects the n$-\Xi$ mass difference, and if charge independence is satisfied, then the electromagnetic form factors of the Λ^0 and Σ^0, and in particular their magnetic moments, vanish. This is independent of any assumed relation between the Λ and Σ interactions, such as global symmetry. It is also shown that the same conditions, together with charge conjugation invariance, imply a generalized form of the Pais-Jost-Pugh theorem about processes involving only meson or photon external lines. If there is still more symmetry for the strong interactions, as in the case where the π interactions are globally symmetric and the K interactions also have this doublet structure, it is shown that the K^0 acts as a completely neutral particle insofar as electromagnetic interactions are concerned. (auth)

889

HYPERON BETA DECAY. C. H. Albright (Princeton Univ., N. J.). Phys. Rev. 115, 750-1(1959) Aug. 1.

The complete electron spectrum is presented for

polarised hyperons undergoing beta decay. Despite the rarity of such events, the availability of polarized hyperons and the favorably large energy release make an experimental analysis of these decays feasible. The basic couplings are assumed to be vector and axial vector, but the new terms which arise from couplings "induced" by the strong interactions are also included. (auth)

890

PROTON-NEUTRON MASS DIFFERENCE. Sigenobu Sunakawa and Katsumi Tanaka (Argonne National Lab., Lemont, Ill.). Phys. Rev. 115, 754-62(1959) Aug. 1.

An expression for the electromagnetic self-mass of a physical nucleon is obtained from the basic postulates of field theory. A complete set of intermediate states is then introduced and the one-nucleon state and the state with one nucleon plus a nucleon pair are taken into account. Direct comparison is thus established between the various methods of obtaining the proton-neutron mass difference. The mass difference is computed by two methods which use the Stanford form factors. It is shown that if the form factor which agrees in the experimental region is used in the nonexperimental region in the nucleon-pair term, then there is a disagreement with the present electromagnetic explanation of the proton-neutron mass difference. (auth)

891

CHARGE INDEPENDENCE IN HYPERON PRODUCTION. Frank S. Crawford, Jr., Roger L. Douglass, Myron L. Good, George R. Kalbfleisch, M. Lynn Stevenson, and Harolld K. Ticho (Univ. of California, Berkeley). Phys. Rev. Letters 3, 394-6(1959) Oct. 15.

The absolute differential cross sections were measured for the reactions $\pi^- + p \rightarrow \Sigma^0 + K^0$ and $\pi^- + p \rightarrow \Sigma^- + K^+$, using 1.09 ± 0.01 Bev negative pions incident on a 10-in. liquid hydrogen bubble chamber, with an 11-kilogauss magnetic field. Results are compared to those of Brown et al. (Phys. Rev. 107, 908(1957)) both as to magnitude and as to angular dependences. (W.D.M.)

892

THEORY OF THE HIGH-ENERGY PEAKS IN PION-NUCLEON CROSS SECTIONS. Wen-Nong Wong and Marc Ross (Indiana Univ., Bloomington). Phys. Rev. Letters 3, 398-400(1959) Oct. 15.

An investigation is reported on whether the spectrum of high-energy peaks observed at 650, 950, and 1300 Mev in π-p scattering can be explained in terms of the conventional low-energy pseudoscalar π-N interaction. A Chew-Low formalism is outlined which predicts two isobars, or metastable states, of the nucleon that may be associated with the 950 and 1300 Mev peaks. (W.D.M.)

893

THE WIGNER DISTRIBUTION FUNCTION FOR SYSTEMS OF BOSONS OR FERMIONS. K. Schram and B. R. A. Nijboer (Rijksuniversiteit, Utrecht). Physica 25, 733-41(1959) Aug.

An expression for the Wigner distribution function valid for systems of bosons or fermions was obtained by making use of correspondence relations between classical quantities and quantum mechanical operators first given by Groenewold. A general and straightforward derivation of the equation of motion for the Wigner distribution function is presented. The equation governing the temperature dependence of the Wigner distribution

function in the case of a canonical ensemble can be derived in a completely analogous way. (auth)

894

A NOTE ON THE INTERACTION BETWEEN NUCLEON AND ANTI-NUCLEON. Alladi Ramakrishnan and N. R. Ranganathan (University of Madras) and S. K. Srinivasan (Indian Inst. of Tech., Madras). Proc. Indian Acad. Sci., Sec. A 50, 91-4(1959) Aug.

The interaction potential between nucleon and antinucleon is derived by using the new Tamm-Dancoff formalism. (auth)

895

NEUTRAL PIONS. J. M. Cassels, D. P. Jones, P. G. Murphy, and P. L. O'Neill (Univ. of Liverpool). Proc. Phys. Soc. (London) 74, 92-6(1959) July.

The angular correlation between the γ rays produced in Panofsky reactions was measured. The results exclude one of the two possible ways of introducing the π_0^0 proposed by Baldin and Kabir. On the conventional assumption that there is only one π^0, it is found that $m_{\pi^-} - m_{\pi^0} = (8.90 \pm 0.14)m_e$; the lifetime of the π^0 must be greater than 3×10^{-22} sec. (auth)

896

THE SPIN OF THE NEUTRAL PION. J. D. Prentice, E. H. Bellamy, and W. S. C. Williams (Univ. of Glasgow). Proc. Phys. Soc. (London) 74, 124-30(1959) July.

An attempt was made to detect effects due to non-zero π-meson spin. The distribution of photons from the decay of neutral π mesons was measured and from the results it is concluded that the spin is zero or that the π mesons observed were not appreciably polarized. (auth)

897

THE MAGNETIC FORM FACTOR OF THE NUCLEON. H. Eisenlohr and H. Salecker (Universität, Freiburg. i. B.). Z. Naturforsch. 14a, 699-707(1959) Aug. (In German)

The form factor of the anomalous magnetic moment distribution of proton and neutron is treated. It is first shown with three examples that the magnetic root mean square radius cannot be taken from the existing experiments with sufficient accuracy. Satisfactory agreement with experimental results can be obtained with arbitrary values of r_m^2. The magnetic moment form factors depending on the energy momentum transfer q^2 in perturbation theory and the 2π meson contribution to the isotopic vector form factor with dispersion relations also in relation to q^2, with and without π meson form factor are calculated. Better agreement of the shape of the form factor with the phenomenological form factor of Hofstadter at the expense of the static magnetic moment is obtained. But the contribution of the high q^2 values is still too large, i.e., the structure is somewhat too concentrated. (auth)

Nuclear Properties and Reactions

898   AFOSR-TR-59-145

Laval Univ., Quebec.

RESEARCH ON THE AUGER ELECTRONS ASSOCIATED WITH BETA-DISINTEGRATION. Final Report. Claude Geoffrion. Aug. 31, 1959. 50p. Contract AF18(600)-1574, Supplemental Agreement No. 1(57-235).

The spectrum of L-Auger electrons from Tl^{208} and Bi^{212} was studied in the region extending from 5 to 13

kev. The energy of 37 lines was determined with a precision varying from 10 to 20 volts. This was realized by using: (a) a carefully calibrated high resolution beta-ray spectrometer; (b) very thin source and source backing; and (c) electron acceleration at the Geiger counter, to obtain full transmission by the counter window. The identification of the transition corresponding to each of the measured lines was done with the help of a new empirical formula for secondary ionization potential. This rule, although still empirical, represents a definite improvement over other empirical formulas. A new table of sixty theoretical values for the rates of various K-Auger transitions was calculated, to replace and complete the incorrect table published twenty years ago by L. Pincherie and used since by many workers. From this new table and from radiative transition rates calculated in the same approximation, K-fluorescence yield values were obtained that are in better agreement with experimental results than most of the previously published values. (auth)

899 ANL-6042
Argonne National Lab., Lemont, Ill.
SPECIFIC ACTIVITIES OF NUCLIDES, Z > 87.
Nadine M. Isaac and John W. Wilkins. Sept. 1959.
11p. Contract W-31-109-eng-38. OTS.

The specific activity of an isotope is expressed as the product of its decay constant and the number of atoms per unit weight. The specific activities of the elements with Z > 87 are calculated in units of disintegrations per minute per microgram. (W.D.M.)

900 CF-56-6-40(Del.)
Oak Ridge National Lab., Tenn.
BASIC INELASTIC NEUTRON DATA FOR AGE CALCULATIONS FOR VARIOUS FUEL AND MODERATOR COMPOSITIONS. C. M Copenhaver. June 6, 1956.
Decl. with deletions Mar. 15, 1957. 14p. Contract [W-7405-eng-26]. OTS.

Graphs were prepared as basic inelastic neutron data requested for neutron age calculations to be made using the compositions $NaF-ZrF_4$, BeF_2, $LiF-BeF_2$, and ZrH. Nuclear temperature as a function of incident neutron energy was obtained for F, Be, and Zr. (W.D.M.)

901 INSJ-20
Tokyo Univ. Inst. for Nuclear Study.
NUMERICAL DIFFERENTIAL CROSS SECTIONS OF ELASTIC AND INELASTIC SCATTERINGS OF PROTONS. I. FROM Ti, Cr, Ni and Zn AT 8, 10, 12, AND 14 MeV. Chuin Hu, Ken Kikuchi, Shinsaku Kobayashi, Kazuhisa Matsuda, Yukio Nagahara; Yukiyasu Oda, Naoyuki Takano, Minoru Takeda, and Takashi Yamazaki.
Sept 1, 1959. 12p.

Differential cross sections of elastic and inelastic scattering of protons from several nuclei at incident energies from 7.5 to 15.8 Mev were measured. Natural foil targets of Ti, Cr, Fe, Ni, and Zn and the incident proton energies of 14 3, 11.9, 9.9, and 7.8 Mev were used. The numerical data are given. (auth)

902 NAA-SR-4164
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
FUNDAMENTALS OF FISSION DAMAGE. J. A. Brinkman. Oct. 15, 1959. 34p. Contract AT-11-1-GEN-8. OTS.

The principle kinds of lattice damage produced in metallic fuels by fission products are discussed both qualitatively and quantitatively. These include interstitial atoms, vacant lattice sites, displacement spikes,

and fission product impurity atoms. Atomistic mechanisms are considered by which these lattice defects can produce such phenomena as growth, swelling, and phase transformations. The phase reversal phenomenon in U-Mo and U-Nb alloys is interpreted as the result of the action of displacement spikes. Swelling results from the agglomeration of the inert gas fission products. Growth is thought to result from the combined effects of displacement spikes and interstitials and vacancies. (auth)

903 NP-7860
Harvard Univ., Cambridge, Mass. Mallinckrodt [Chemical] Lab. and Harvard Univ., Cambridge, Mass. Lyman Lab. [of Physics].
$N^{14}-N^{15}$ HYPERFINE ANOMALY. L. Wilmer Anderson, Francis M. Pipkin, and James C. Baird, Jr. [1959]. 49p. Contract Nonr-1866.

The optical transmission of an optically oriented sodium vapor in spin exchange equilibrium with atomic nitrogen was used to measure the zero field hyperfine splitting of N^{14} and N^{15}. The nuclear moments of N^{14} and N^{15} were measured by observing the effect of saturating the nitrogen resonance on the proton resonance in NH_4^+. A hyperfine anomaly was obtained by combining these measurements. The mechanism of spin exchange collisions is discussed. (auth)

904 NP-7968
Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics.
EINE FELDTHEORETISCHE VERALLGEMEINERUNG DER IMPULSNÄHERUNG. (A Field Theoretical Generalization of the Pulse Approximation). F. Kaschluhn. 1959. 27p. (P-332).

A field-theoretical generalization of Chew's pulse approximation is proposed as it is necessary for an explicit evaluation of the contribution from the nonobservable region in the dispersion relations for pion-deuteron scattering. The Hamilton formalism for a non-relativistic two-nucleon system is assumed with a pseudovector coupling to the pion field for which the usual cut-off is used. The generalization to the case of more than two nucleons and to other couplings is obvious and should also be possible—using the appropriate modifications—to the relativistic case. The time-dependent scattering formalism is used. The S-matrix describes transitions between the bare states of the two-nucleon system, which are defined as the projections of the corresponding real states onto the meson vacuum. This leads directly to the introduction of a field-energy operator which involves self-energies and interaction between the nucleons and by means of which it is possible to avoid the difficulties associated in general with the bound state problem in quantum field theory. It is shown that the higher approximations to the pulse approximation correspond also in the field-theoretical case to the potential and multiple scattering corrections which also include the absorption phenomena. (auth)

905 OOR-2140:2
Florida State Univ., Tallahassee.
VIBRATIONAL STATES IN DEFORMED EVEN-EVEN NUCLEI. INTERIM TECHNICAL REPORT NO. 2 ON EXPERIMENTAL STUDY OF NUCLEAR MODELS. II. NUCLEAR LEVELS DETERMINED BY INELASTIC SCATTERING. Raymond K. Sheline. June 1, 1959. 70p. Contracts DA-01-009-ORD-705 and AT(40-1)-2434. OTS.

The question of the validity of nuclear vibrations is discussed, and an attempt is made to understand the relationships between the collective states in spherical and deformed even-even nuclei. The approach is largely an empirical one employing (1) a collection and systemization of all experimental rotational and vibrational states in the regions of interest, (2) an attempt to calculate additional β and α vibrations for deformed even-even nuclei, and (3) a summary of the Coulomb excitation of vibrational states whose Coulomb excitation cross-sections should be enhanced if these states are really collective in nature. (auth)

906 TID-8511
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
SMALL-SIZED ORGANIC MODERATED REACTORS (10-40 MWE). Oct. 10, 1959. 45p. OTS.

The demonstration of reasonably economic nuclear power from an organic moderated reactor in the size range of from 10 to 40 Mw(e) holds considerable promise. The technology and economics of the organic moderated reactor in this size range are summarized utilizing present day technology. The technological foundation for the organic moderated reactor is established in terms of a review of the experience derived from the Organic Moderated Reactor Experiment both in design and operation; a review of the design and development of the Piqua OMR with particular emphasis being given to the development of systems and components; a review of the research and development associated with the determination of fundamental properties of organic coolants; and a review of the status of the fuel technology related to organic moderated reactors. The preliminary technical characteristics and economic data for three plant sizes, 10, 20, and 40 Mw(e), are presented. The cost difference of nuclear and conventional generated steam is discussed and a summary of pertinent economic characteristics is presented. The economic data presented are based on a capital charge rate of 7% which includes interest, amortization, taxes, and insurance. Escalation beyond March 1959 and interest during construction is not included. The fuel costs assume a uranium use charge of 4% and Pu credited at $15/gm as nitrate. Sufficient information is presented to permit the selection of a plant which is consistent with the consideration of budget appropriations and the various possible plant locations. The economics of a 10 to 40 Mw(e) OMR plant constructed in power cost areas ranging from 4 to 16 mills/kwh are discussed. The detailed design of a particular size plant suitable for the basis of a Title I study would, in all probability, yield more favorable economics because of the associated optimization of the design parameters and the resulting reduction of the uncertainty of the cost element. (auth)

907 UCRL-5596
California. Univ., Livermore. Lawrence Radiation Lab.
GAMMA RAYS FROM THE INTERACTION OF 14-Mev NEUTRONS WITH BERYLLIUM. J. Benveniste, A. C. Mitchell, C. D. Schrader, and J. H. Zenger. June 9, 1959. 40p. Contract W-7405-eng-48. OTS.

The cross section for the $Be^9(n, t')Li^{7*} \rightarrow Li^7 + \gamma$ (0.477 Mev) reaction was measured in the vicinity of 14 Mev by detecting the gamma rays at scattering angles from 30 to 150 degrees. A time-of-flight technique was used to distinguish the gamma rays from the high

neutron background. The cross section drops from 20 mb at 13.6 Mev to 10 mb at 14.1 Mev and then rises to 30 mb at 14.7 Mev. (auth)

908 USNRDL-TR-350
Naval Radiological Defense Lab., San Francisco.
CROSS SECTIONS FOR THE (n,2n) REACTION IN N^{14}, P^{31}, Cu^{63}, and Pr^{141}. W. E. Thompson and J. M. Ferguson. Aug. 5, 1959. 20p.

The (n,2n) cross sections have been measured for N^{14}, P^{31}, Cu^{63}, and Pr^{141}, for energies from 12.5 to 18 Mev. The annihilation radiation emitted from the product nuclides was counted with two NaI(Tl) crystals in coincidence. The data are compared with curves plotted from Weisskopf's theoretical expression for (n,2n) cross sections. (auth)

909 AEC-tr-3861
MEAN NUMBER OF NEUTRONS EMITTED DURING Th^{229} FISSION BY THERMAL NEUTRONS. V. I. Lebedev and V. I. Kalashnikova. Translated by Lydia Venters (Argonne National Lab.) from Zhur. Eksptl'. i Teoret. Fiz. 35, 535-6(1958). 4p. JCL or LC.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 3343.

910 AEC-tr-3862
γ-RAYS ACCOMPANYING FISSION OF U^{238} BY NEUTRONS WITH ENERGY OF 2.8 AND 14.7 Mev. A. N. Protopopov and B. M. Shiryaev (Shiriayev). Translated by Lydia Venters (Argonne National Lab.) from Zhur. Eksptl'. i Teoret. Fiz. 36, 954-5(1959). 4p. JCL or LC.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 13003.

911 AEC-tr-3864
ON THE PROBLEM OF EMISSION MECHANISM OF PROMPT FISSION NEUTRONS. V. S. Stavinskii. Translated by Lydia Venters (Argonne National Lab.) from Zhur. Eksptl'. i Teoret. Fiz. 36, 629-30(1959). 4p. JCL or LC.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 10534.

912
ANGULAR CORRELATION BETWEEN NEUTRINO AND GAMMA QUANTUM IN L-CAPTURE. K. Nagy (Roland Eötvös Univ., Budapest). Acta Phys. Acad. Sci. Hung. 10, 199-219(1959).

The angular correlation between a longitudinally polarized neutrino and a circularly polarized γ quantum released by L capture was determined. For the form of the weak interaction the linear combination of S, V, T, A, and P couplings was supposed. The angular correlation was calculated for arbitrary γ transitions and for captures forbidden in any order. As a special case the ν-γ angular correlation by an allowed L capture was also given. (auth)

913
BREMSSTRAHLUNG FROM A 31-Mev BETATRON AND (γ,α) REACTIONS. Georges Boulègue. Ann. Phys. 4, 813-63(1959) July-Aug. (In French)

The measurement of the bremsstrahlung of a betatron, indispensable in interpretation of experiments, can be effected by an ionization method or by precise and absolute measurement of a nuclear reaction. One radioactivity measurement furnishes a permanent and ready

control of the measuring apparatus. The (γ, α) reactions produced by the betatron beam can be studied by the nuclear plate technique if precautions are taken to protect the plates against radiation and eliminate parasitic tracks. For relatively thick targets an interpretation procedure is given. Alpha track statistics for Cu, Ni, and Al give emission spectra above 3.5 Mev. The Cu result agrees with values found in the literature; the other two values are new. The number of particles emitted under the action of a given spectrum (or by x rays) has been calculated. It agrees with a published result for Cu. One estimate of the maximum (γ, α) cross section agrees with the only previous measurement on Cu^{65}; this gives an indication for Al and Ni. The evaporation theory, made up of different usually admissible hypotheses, gives an α emission curie for Cu analogous to the experimental one. However, to obtain excellent agreement one must adopt a level density conforming to certain experimental results, but slightly different from that usually chosen. Nickel gives rise to the same remarks. The evaporation theory can be applied only roughly to Al. (tr-auth)

914

s- AND p-WAVE NEUTRON SPECTROSCOPY. PART I. PEAK HEIGHT ANALYSIS AND LEVEL ASSIGNMENTS. E. Merzbacher (Univ. of North Carolina, Chapel Hill) and P. W. Crutchfield, Jr. and H. W. Newson (Duke Univ., Durham, N. C.). Ann. Phys. (N. Y.) 8, 194-210 (1959) Oct.

Methods for analyzing transmission measurements of neutron resonances in the kev region are discussed. The "peak height" and the "double difference" methods are described in detail. To illustrate the methods of analysis, the spins and widths of several compound nucleus states in sodium and fluorine are determined from experimental data. The assignments are 1^+ and 3^- for the 3- and 53-kev resonance in sodium, respectively; 2^- and 1^- for the 27- and 49-kev resonances in fluorine; and 2^+ for the 36-kev resonance in aluminum. Some details of the sodium cross section between 1 and 100 kev are discussed. (auth)

915

s- AND p-WAVE NEUTRON SPECTROSCOPY. PART II. EVEN-EVEN NUCLEI. H. W. Newson, R. C. Block, P. F. Nichols, A. Taylor, and A. K. Furr (Duke Univ., Durham, N. C.) and E. Merzbacher (Univ. of North Carolina, Chapel Hill). Ann. Phys. (N. Y.) 8, 211-22 (1959) Oct.

Total cross sections were measured for Ni^{58}, Ni^{60}, Ce^{140}, Ce^{142}, Mg^{24}, Mg^{25}, Mg^{26}, Si^{28}, Zr^{90}, Zr^{92}, and Zr^{94} from 3 to 300 kev. Of the eight well separated levels found in Ni^{58}, six are matched by levels in Ni^{60} at very nearly the same energies. This effect is very difficult to understand on the basis of conventional nuclear models. Strength functions (Γ_n^0/D) of 3.4×10^{-4}, 2.3×10^{-4}, 1.0×10^{-4}, and 1.2×10^{-4}, and average level spacings of 23, 21, 3, and 1 kev were estimated for Ni^{58}, Ni^{60}, Ce^{140}, and Ce^{142}, respectively. The strength functions and level spacings of the Zr isotopes are difficult to interpret because of the importance of both s- and p-wave resonances; however, a preliminary average cross-section analysis of Zr and neighboring nuclei shows a very definite peak in the p-wave strength function at atomic weight 92. Resonance parameters were obtained for resonances observed in the magnesium isotopes. (auth)

916

s- AND p-WAVE NEUTRON SPECTROSCOPY. PART III. AREA ANALYSIS OF NEUTRON RESONANCES. Kamal K. Seth (Duke Univ., Durham, N. C.) Ann. Phys. (N.Y.) 8, 223-49(1959) Oct.

In the commonly used methods of area analysis of neutron resonances observed in transmission experiments, the interference between resonance and potential scattering is either neglected or taken into account only approximately. A method of analysis is developed which takes into account such interference accurately. It is shown that the importance of the interference effect in obtaining Γ or $g\Gamma_n$ is determined not only by the size of the potential phase shift, but also by the sample thickness. Results of calculations are presented and it is shown that the errors inherent in the conventional methods of analysis due to the neglect of interference effect can become abnormally large in certain cases. Such cases are usual in the kev region of neutron energy and not uncommon in the ev region. In the kev region of neutron energy certain cases also occur in which the conventional area is close to zero and leads to very inaccurate determination of widths. For such cases a new method of area analysis is proposed. Some applications of the new analysis techniques for analysis of individual resonances are presented. (auth)

917

s- AND p-WAVE NEUTRON SPECTROSCOPY. PART IV. EXPERIMENTAL METHODS IN THE kev REGION. P. F. Nichols, E. G. Bilpuch, and H. W. Newson (Duke Univ., Durham, N. C.). Ann. Phys. (N. Y.) 8, 250-65 (1959) Oct.

A new high-resolution collimation-detection system was developed for neutron total cross-section measurements in the kev region. The instrument has a variable opening between conical polyethylene collimating surfaces and admits neutrons emitted from the Li(p,n)Be reaction at about 160° with respect to the direction of the protons. The neutrons are detected by two separate banks of boron trifluoride counters. Neutron energy spread is relatively constant over a wide range of neutron energies. The resolution is apparently limited at present by nonuniformity of the thin Li targets. The optimum resolution obtainable with a reasonable counting rate was calculated. Measurements were made of the yield at 160° of the small extraneous background scattered into the detectors by the target backing and other sources. The total cross section for Bi^{209} was measured from 10 to 136 kev; prominent s-wave resonances occur at 12, 15, 32, 44.5, 68, 80, 84, 94, 101, 112, 116, and 134 kev in addition to five other less prominent levels and three known resonances below 10 kev. A resolution correction was applied to the first four resonances and the peak cross sections corrected in this manner are close to the theoretical values. The average level spacing is 10 ± 3 kev per s-wave channel (spin state). The s-wave strength function based on more than twenty resonances is $(0.57 \pm 0.17) \times 10^{-4}$. (auth)

918

DETERMINATION OF THE NUCLEAR QUADRUPOLE MOMENTS OF THE RADIOACTIVE ISOTOPES Cs^{135} AND Cs^{137}. H. Bucka, H. Kopfermann, and E. W. Otten (Universität, Heidelberg, Ger.). Ann. Physik 4, 39-49 (1959). (In German)

High frequency transitions in the hyperfine structure of the excited 7 $^2P_{3/2}$ terms of the Cs I-spectrum were

detected by means of the double resonance method. The measurements were made on a 0.2 mc sample of a fission product which contained the radioisotopes Cs^{135} and Cs^{137} as well as the stable isotope Cs^{133} in approximately equal concentrations. For the nuclear quadrupole moments of the radioisotopes the values $Q(Cs^{135})$ = $(+0.049 \pm 0.002) \times 10^{-24}$ cm^2 and $Q(Cs^{137})$ = $(+0.050 \pm 0.002) \times 10^{-24}$ cm^2 were obtained. (tr-auth)

919

THE ENERGIES AND RELATIVE PAIR PRODUCTION CROSS SECTIONS FOR Zn^{65} AND Na^{22} GAMMA RAYS. P. P. Singh, H. W. Dosso, and G. M. Griffiths (Univ. of British Columbia, Vancouver). Can. J. Phys. 37, 1055-8(1959) Sept.

The gamma-ray energies for Zn-65 were determined to be 1.1124 ± 0.0019 Mev and for NA-22, 1.2736 ± 0.0018 Mev. Relative pair production cross sections in sodium iodide are reported for Co-60, Na-22, and RdTh. (C.J.G.)

920

ROTATIONAL STATES OF EVEN-EVEN NUCLEI. G. R. DeMille, T. M. Kavanagh, R. B. Moore, R. S. Weaver, and W. White (McGill Univ., Montreal). Can. J. Phys. 37, 1036-43(1959) Sept.

Rotational energy levels of axially asymmetric nuclei were calculated in the manner of Davydov and Filippov, and a comparison with experiment shows good quantitative agreement. It is suggested that agreement may be improved by introducing the Bohr-Mottelson vibration-rotation interaction and a centrifugal stretching correction analogous to the type used in molecular spectra. The D-F method seems to be particularly useful for nuclei in the transition regions between "rotational" and "near-harmonic" modes of collective excitation. (auth)

921

THE DECAY OF Mg^{23}. R. S. Storey and K. G. McNeill (Univ. of Toronto). Can. J. Phys. 37, 1072-4(1959) Sept.

The existence of an allowed transition from the ground state of Mg-23 to the 0.44-Mev excited state of Na-23 is reported. (C.J.G.)

922

EXCHANGE REACTION OF 90-Mev PROTONS ON DEUTERONS. D. R. Firth (McGill Univ., Montreal). Can. J. Phys. 37, 1074-5(1959) Sept.

The reaction of 90-Mev protons on deuterons was investigated by means of a diffusion cloud chamber filled to 19 atmospheres with deuterium. Photographs, taken 120 msec after 90-Mev proton pulses were sent through the chamber, reveal that about one out of six events is due to charge exchange. The neutron-proton exchange force is concluded to be spin dependent. (C.J.G.)

923

THE DECAY OF Bi^{208}. C. H. Millar, T. A. Eastwood, and J. C. Roy (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Can. J. Phys. 37, 1126-36(1959) Oct.

It was observed that Bi^{208} decays mainly by K- and L-electron capture to the 2.615-Mev first-excited level of Pb^{208}. Decay to known Pb^{208} levels above the 2.615-Mev level has been shown experimentally not to occur in more than 3% of the Bi^{208} disintegrations, in agreement with an analysis of the mass differences in this region which indicates that such decay modes are en-

ergetically impossible. Positrons are not emitted in more than 5% of Bi^{208} disintegrations. The value of the ratio of K x rays to 2.615-Mev γ rays has been measured to be 0.23 ± 0.01. Assuming that the ground state of Bi^{208} is 5^+ and that the theory of Brysk and Rose is accurate in the region near the K-capture threshold, this ratio measurement leads to a value of 2.807 Mev for the total decay energy of Bi^{208}. This agrees with the value 2.75 ± 0.10 Mev obtained from reaction cycle analysis. New measurements of the Bi^{208} half-life have revealed an error in the previous measurement, the best value now being 7.5×10^5 years to within a factor of three. Incidental to the main experiment an upper limit of 0.5% was measured for the positron decay of Bi^{207}. (auth)

924

THE PHOTODISINTEGRATION OF NEON. H. J. Hay and J. B. Warren (Australian National Univ., Canberra). Can. J. Phys. 37, 1153-65(1959) Oct.

A proportional counter, filled to 4-atmosphere pressure with pure neon, and a cylindrical gridded ionization chamber, filled to 9-atmosphere pressure with neon containing some helium, were irradiated with the gamma-ray flux from a thick lithium target bombarded with 500-kev protons. Pulse height analysis led to the assignment of the following photodisintegration cross sections in millibarns: $Ne^{20}(\gamma_{17.6}, \alpha)O^{16}$, 0.05 to the ground state of O^{16}, 0.67 to the 6.06- and 6.14-Mev levels of O^{16}, 1.80 to the 6.91- and 7.12-Mev levels of O^{16}; $Ne^{20}(\gamma_{14.8}, \alpha)O^{16}$, 0.086 to the ground state, about 1.0 to the 6.06- and 6.14-Mev levels; $Ne^{20}(\gamma_{17.6}, \rho)F^{19}$, 21 to the ground and low-lying levels at 110, 197 kev in F^{19}, about 5 to the 1.35- and/or 1.57-Mev levels in F^{19}; $Ne^{22}(\gamma_{17.6}, \alpha)O^{18}$, 0.76 to the ground level. The $Ne^{20}(\gamma, \alpha)$ O^{16} cross sections are in good accord with the selection rules put forward by Gell-Mann and Telegdi for the photodisintegration of an even-even nucleus. (auth)

925

A NOTE ON s-WAVE AVERAGE NEUTRON CROSS SECTIONS. Kamal K. Seth (Duke Univ., Durham, N. C.). Can. J. Phys. 37, 1199-1202(1959) Oct.

Expressions are given for obtaining s-wave average neutron cross sections and for analyzing total neutron cross-section data in the region of Li(p,n) neutron energies. The second expression is valid only if the experiment measures true cross section. Percentage error in different approximations for exact s-wave average cross sections is compared to the error in the Lane and Lynn approximation. (C.J.G.)

926

ZERO SPIN OF THE 1265-kev STATE IN Pt^{194}. M. W. Johns and J. D. MacArthur (McMaster Univ., Hamilton, Ont., Can.). Can. J. Phys. 37, 1205-6(1959) Oct.

Angular correlation studies in Ir-194 indicate that the third excited state of Pt-194 has zero spin and presumably, even parity. (C.J.G.)

927

γ RADIATION FROM THE DISINTEGRATION OF $_{51}Sb^{127}$. Horacio Bosch and Herman Munczek (Comisión Nacional de Energía Atómica, Buenos Aires). Ciencia e invest. (Buenos Aires) 12, 244-8(1956) June. (In Spanish)

The γ radiation from the disintegration of the $_{51}^{127}Sb$ has been studied by means of a scintillation spectrometer. A detail of the contribution of Compton background is given. The intensities and periods of the

photopeaks have been determined taking into account the contribution of Compton background. A new period of 149 ± 4 hours was found. (auth)

728

(n,γ)-SPECTRA OF IODINE, CESIUM, AND IRIDIUM. R. Balzer, H. Knoepfel, J. Lang, P. Stoll, and W. Wölfli (Eidgenossche Technische Hochschule, Zurich). Helv. Phys. Acta 32, 264-6(1959). (In German)

The spectra from (n,γ) reactions on I^{127}, Cs^{133}, Ir^{191}, and Ir^{193} were measured in the energy range over 3 Mev. The absolute and relative sensitivity of the pair spectrometer used was theoretically and experimentally determined so that it was possible to indicate not only the energy but also the intensity in number of quanta per 100 neutron captures for each resolved gamma line. The results are tabulated. (J.S.R.)

729

(p,nγ) REACTIONS OF Co^{59} AND As^{75}. B. Lobkowicz and P. Marmier (Eidgenossche Technische Hochschule, Zurich). Helv. Phys. Acta 32, 266-8(1959). (In German)

The energy levels of Ni^{59} and Se^{75} were determined by a study of the gamma spectra emitted in (p,nγ) reactions of Co^{59} and As^{75}. The energies and relative intensities of the gamma lines are tabulated, and the level schemes of Ni^{59} and Se^{75} are given. (J.S.R.)

730

ABSOLUTE MEASUREMENT OF TWO FLUORINE RESONANCES. A. Lippold, J. W. Müller, H. H. Staub, and H. Winkler (Universität, Zurich). Helv. Phys. Acta 32, 268-70(1959). (In German)

An absolute determination was made of the two $F^{19}(p,\alpha\gamma)O^{16}$ resonances between 1.3 and 1.4 Mev. The yield curves obtained are shown. The resonance energy and half width were calculated with corrections made for the energy dependence of the penetrability, the effect of adjacent resonances, and target thickness and straggling in thin targets. Resonance values of 1344.5 ± 1.0 and 1373.0 ± 1.0 kev with half widths of 4.5 ± 1.0 and 13.5 ± 1.0 kev, respectively. The results are compared with those obtained by previous investigators. (J.S.R.)

731

GAMMA ACTIVITY OF THE PRODUCTS OF THERMAL FISSION OF URANIUM-235 AFTER A SHORT DECAY. Maurice Gauzit and Roger Danon. Inds. atomiques 3, No. 7-8, 63-72(1959). (In French)

For gamma activity of U^{235} at very short cooling times, 0 to 100 sec, there is no compilation analog; the calculations would be extremely difficult in view of the number of fission products involved and the lack of information about yields, periods, etc. An analog scheme which uses the same weighting factors and the most recent data of Perkins and King leads to different results. Curves analogous to those of Clark, and Perkins and King were obtained for cooling times less than a few seconds. (T.R.H.)

732

A REINVESTIGATION OF THE DECAY OF Na-22. M. K. Ramaswamy (Johns Hopkins Univ., Baltimore). Indian J. Phys. 33, 285-94(1959) July.

The amount of positron emission in the decay of Na-22 has been determined to be 0.899 ± 0.003 using a 4π plastic beta scintillation spectrometer in conjunction with double and triple coincidence techniques. This leads to an $\epsilon/\beta+$ ratio of 0.112 ± 0.004 which is slightly better than the best earlier result of Sherr and Miller.

Comparison of the measured value with the theoretical ratio of 0.1135 ± 0.002 leads to a value for the Fierz interference term $b_{GT} = -0.004 \pm 0.012$, showing the extreme smallness of the cross term in allowed Gamow-Teller transitions. In the appendix a brief summary of the status of the Fierz term is presented. (auth)

733

METHOD FOR THE ANALYSIS OF MULTICOMPONENT EXPONENTIAL DECAY CURVES. Donald G. Gardner (Westinghouse Electric Corp., East Pittsburgh, Penna.); Jeanne C. Gardner and George Laush (Univ. of Pittsburgh); and W. Wayne Meinke (Univ. of Michigan, Ann Arbor). J. Chem. Phys. 31, 978-86(1959) Oct.

A frequently encountered problem in many branches of science involves the resolution of experimental data into a sum of independent exponential curves of the form

$$f(t) = \sum_{i=1}^{n} N_i \exp(-\lambda_i t),$$ in order to estimate the physically

significant parameters N_i and λ_i. The numerical evaluation of a mathematical approach to the problem based on the inversion of the Laplace integral equation by a method of Fourier transforms is presented. The results of the analysis appear in the form of a frequency spectrum. Each true peak in the spectrum indicates a component, the abscissa value at the center of the peak is the decay constant λ_i, while the height of the peak is directly proportional to N_i/λ_i. Results obtained on an IBM 650 computer indicate that the method may possess certain advantages over previous methods of analysis. (auth)

734

THE OCCURRENCE OF DELAYED-NEUTRON PRECURSORS. W. John and F. J. Lombard (Univ. of California, Livermore). J. Inorg. & Nuclear Chem. 11, 81-3(1959) Sept.

A survey of the isotope tables for delayed-neutron precursors was made for odd-Z nuclei having neutron numbers greater than the magic numbers by either two or three. The quantity $Q_\beta - B_n$ was calculated for each case from known data or from energy systematics to determine if neutron emission is energetically possible. Among the fourteen non-fission products examined, two are known delayed-neutron precursors. In only one other case, namely Tl^{209}, is there a possibility of delayed-neutron emission. The sixteen fission products considered include four known precursors, two nuclei previously suggested as precursors and three uncertain cases. In all the other cases delayed-neutron emission is energetically impossible. (auth)

735

HALF-LIFE OF ^{239}Np. D. Cohen, J. C. Sullivan, and A. J. Zielen (Argonne National Lab., Lemont, Ill.). J. Inorg. & Nuclear Chem. 11, 159-61(1959) Sept.

The best value for the half life of neptunium-239 was determined to be 2.359 ± 0.010 days. (C.J.G.)

736

MEASUREMENT OF DELAYED COINCIDENCES IN Sn^{116}. A. Meessen and L. Grenacs (Université, Louvain, Belg.). J. phys. radium 20, 764-8(1959) Aug.-Sept.

Angular correlation measurements on gamma cascades in Sn^{116} indicated a perturbation when gammas with a delay greater than 10^{-8} sec are admitted. Delayed coincidence measurements led to discovery of a prompt cascade and a delayed cascade with a ratio of delayed to prompt of 1.7. (T.R.H.)

737

TWO BODY FORCES IN LIGHT DEFORMED NUCLEI.
D. M. Brink (Clarendon Lab., Oxford) and A. K. Kerman
(Massachusetts Inst. of Tech., Cambridge). Nuclear
Phys. 12, 314–26(1959) Aug. (1).

There is evidence that the light nuclei in the alumi-
num region have rotational states. It is known from
studies of heavy rotating nuclei that an independent
particle model for a deformed well, as used by Nilsson,
is a good approximation for many of the properties of
these collective states. However, it has been clear for
some time that two body correlations are important for
a more complete understanding of the situation. Because
the number of single particle states for the light nuclei
is relatively small and because isobaric spin is a good
quantum number, studies on the effect of two body forces
on binding energies and energy levels were undertaken.
The method of Bacher and Goudsmit was employed to
find relations among binding energies which depend only
upon the existence of two body forces and the assump-
tion that the deformed wave function coupling scheme is
a good first approximation. The relations so obtained
are well fulfilled by the data while corresponding rela-
tions obtained for the spherical shell model are not.
Some of the possible excited states in these nuclei are
also discussed and estimates made of their energies.
(auth)

738

PHOTOPRODUCTION OF NEUTRAL PIONS OF HY-
DROGEN NEAR THE THRESHOLD. V. I. Goldan-
skii, B. B. Govorkov, and R. G. Vassilkov (P. N.
Lebedev Physical Inst., Academy of Sciences, Moscow).
Nuclear Phys. 12, 327–32(1959) Aug. (1).

The angular distribution of photo-π^0-mesons produced
on protons is studied near the threshold for γ-ray en-
ergies of 160 to 220 Mev. The distribution can be repre-
sented by the formula $d\sigma/d\Omega = A + B \cos\theta + C \cos^2\theta$,
which corresponds to creation of π^0 mesons in the S-
and P-states. Absolute values of the coefficients A, B,
C, in the indicated energy region are presented. The
experimental values of B/A and C/A are compared with
the theoretical formulas of Watson and Feld. The ratio
of the cross sections for photoproduction of π^+ and π^-
mesons near the threshold was derived from the value
of the γ-ray energy corresponding to B = 0 (260^{+20}_{-10} Mev)
and on basis of data on π meson–nucleon scattering. The
ratio thus found is $\sigma + /\sigma - = 1.30 \pm {}^{0.19}_{0.05}$. (auth)

939

ANGULAR CORRELATION OF INTERNAL CONVERSION
PAIRS DETECTED IN A NEUTRON AND GAMMA
BACKGROUND. APPLICATION TO N^{14}, Be^{10}, AND
B^{10}. S. Gorodetzky, P. Chevallier, R. Armbruster, and
G. Sutter (Institut de Recherches Nucléaires, Stras-
bourg). Nuclear Phys. 12, 349–55(1959) Aug. (1). (In
French)

The determination of nuclear electromagnetic transi-
tions by angular correlations of internal conversion
pairs is extended to reactions induced by deuterons.
The neutron and gamma background is eliminated by
the adjunction of thin crystals to the usual β scintillation
spectrometer. This technique is applied to certain
transitions in N^{14}, Be^{10}, and B^{10}. (auth)

940

DECAY OF Pm^{148}. S. K. Bhattacherjee and Bladev
Sahai (Tata Inst. of Fundamental Research, Bombay)
and C. V. K. Baba (Atomic Energy Establishment,

Trombay, India). Nuclear Phys. 12, 356–70(1959)
Aug. (1).

The radiations arising from the activities of Pm^{148}
produced by proton bombardment of Nd^{148} (93% enriched)
were studied by a coincidence scintillation spectrom-
eter. Gamma rays at 560, 900, and 1460 kev are asso-
ciated with the 4.2-day activity, while the gamma rays
associated with the decay of the 46-day activity are 105,
195, 295, 400, 560, 630, 720, 930, 1015, and 1200 kev, of
which 560 and 630 are the most intense and of equal in-
tensity. Beta-gamma and gamma-gamma coincidence ex-
periments show that the main levels in Sm^{148} arising
from the negaton decay of the 46-day Pm^{148} are 560, 1190,
1590, 1910, 2120, and 2205 kev, the highest energy beta-
group associated with this activity is 2330 kev which
goes to the ground state of Sm^{148}. A tentative decay
scheme is proposed for the 46-day Pm^{148} activity.
(auth)

941

LEVELS IN Gd^{156} EXCITED IN THE DECAY OF 5.6 d
Tb^{156}. P. Gregers Hansen, O. B. Nielsen, and R. K.
Sheline (Univ. of Copenhagen). Nuclear Phys. 12, 389–
412(1959) Aug. (1).

The decay of 5.6 day Tb^{156} was studied by means of a
six gap β-ray spectrometer, scintillation spectrometers,
and coincidence techniques. Conversion electron and
γ-ray coincidence measurements were used extensively
for obtaining quantitative estimates of γ-ray intensities.
A description of the electronic equipment is given, in-
cluding a scaler and gate unit, which improves the
performance of a relatively slow ($\tau = 700$ μsec) multi-
channel analyzer. 24 transitions are assigned to Tb^{156}.
Multipole orders are given in most cases. Levels are
proposed and their quantum numbers (K, I, π) are given
in parenthesis for 89 kev (0, 2^+), 199 kev (0, 4^+), 584
kev (0, 6^+) 1126 kev (tentative), 1152 kev (2, 2^+), 1246
kev (2, 3^+), 1507 kev (4, 4^+), 1620 kev (4, 5^+), 1931 kev
(3^-), and 2042 kev (4^-). Violation of K-selection rules
and significant deviations from the expected branching
ratios for transitions to a rotational band are observed.
These features are discussed in terms of a probable
mixing of the rotational bands. (auth)

942

HALF-LIVES OF TWO EXCITED STATES OF Gd^{156}.
R. E. Bell and M. H. Jorgensen (Univ. of Copenhagen).
Nuclear Phys. 12, 413–17(1959) Aug. (1).

The half lives of the 1507 kev and 89 kev excited
states of Gd^{156} were measured with a fast time-to-
amplitude converter. The half life of the 1507 kev 4+
state is $(1.88 \pm 0.10) \times 10^{-10}$ sec. The half life of the
89 kev first rotational state is $(2.19 \pm 0.07) \times 10^{-9}$ sec,
differing slightly from a previous measurement. The
new value leads to a reduced transition probability for
the reverse (Coulomb excitation) process $B(E2) : e^2 =
(4.64 \pm 0.20) \times 10^{-48}$ cm^4. (auth)

943

A STUDY OF THE ENERGY LEVELS OF A^{37}, Sc^{45},
AND Cr^{51}. A. T. G. Ferguson and E. B. Paul (Atomic
Energy Research Establishment, Harwell, Berks, Eng.).
Nuclear Phys. 12, 426–31(1959) Aug. (1).

Thresholds for neutron emission resulting from
proton bombardment of Cl^{37}, Ca^{45} and V^{51} were observed.
Four excited states in Ar^{37}, nine excited states in Sc^{45}
and nine excited states in Cr^{51} were established and the
corresponding Q values determined to about ±10 kev.
The threshold detector used is briefly described. (auth)

944

INTERNAL BREMSSTRAHLUNG FROM P^{32}. Börje Persson and Sven A. E. Johansson (Univ. of Lund, Sweden). Nuclear Phys. 12, 432-45(1959) Aug. (1).

The spectrum of internal bremsstrahlung from P^{32} was measured in a coincidence experiment. The β particles are detected by an anthracene scintillation spectrometer and the bremsstrahlung spectrum measured by a sodium iodide scintillation spectrometer. Pulses in a certain energy range are selected in the anthracene spectrometer by a single channel analyzer. They are used to gate the 100 channel analyzer which records the bremsstrahlung spectrum. The angle of emission between the β particles and the bremsstrahlung is defined by the orientation of the spectrometers. The experiment was performed for a number of different angles. (auth)

945

ON SPONTANEOUS FISSION RATES. Sven A. E. Johansson (Univ. of Lund, Sweden). Nuclear Phys. 12, 449-64(1959) Aug. (2).

An attempt is made to explain the irregular behavior of the spontaneous fission half lives. The influence of a single nucleon on the barrier height is calculated from the level scheme of Nilsson. In many cases the single particle effect changes the barrier height quite considerably compared to the smooth change expected from the liquid drop model. The calculated changes are compared with the experimental data and are found to account quantitatively for the irregularities. Predictions of spontaneous fission half lives are made for the heavier nuclei and the application of these predictions to some problems is discussed. (auth)

946

THE SPIN ASSIGNMENTS OF THE 9.16-Mev AND 6.44-Mev STATES IN N^{14}. H. J. Rose, W. Trost, and F. Riess (Freiburg Univ.). Nuclear Phys. 12, 510-20 (1959) Aug. (2).

A study was made of the gamma-ray cascade emitted by the 9.16 to the 6.44-Mev state and from this to the ground state of N^{14}, using the reaction $C^{13}(p,\gamma)N^{14}$ at the 1.75 Mev resonance. By means of angular correlation and distribution measurements, using different geometrical arrangements relative to the beam, the 9.16-Mev state was assigned $J = 2$ and the 6.44-Mev state $J = 3$. (auth)

947

A NEW ISOTOPE OF GADOLINIUM VERY DEFICIENT IN NEUTRONS. J. Olkowsky, M. Le Pape, I. Gratot, and L. Cohen (Centre d'Etudes Nucléaires, Saclay, France). Nuclear Phys. 12, 527-31(1959) Aug. (2).

An isotope of gadolinium was obtained from (α,xn) reactions on Sm-144. The half-life is measured to be 24 ± 1 min. It decays by electron capture and β^+-emission. The branching ratio β^+/X_k is 35%. Beta-energy, determined by absorption method, indicates that $E_{max} = 2.5$ Mev. This isotope shows a 780 kev γ-ray. Its mass is 144 or 145. (auth)

948

EXCITED STATES OF ^{166}Er. P. Boskma and H. De Waard (Rijksuniversiteit, Groningen, Netherlands). Nuclear Phys. 12, 533-51(1959) Sept. (1).

The level scheme of Er^{166} was studied from the decays of $Ho^{166}*$ (>30y) and Tm^{166}(7.7h) by means of scintillation and β-spectroscopic coincidence techniques.

A discussion is given about the character of the excited states of Er^{166}. (auth)

949

THE DETERMINATION OF NEUTRON RESONANCE PARAMETERS OF TUNGSTEN BY THE TRANSMISSION METHOD. F. W. K. Firk and M. C. Moxon (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Phys. 12, 552-62(1959) Sept.(1).

The neutron transmission of tungsten from 25 to 200 ev was measured with a resolution of 0.01 μsec $\times$ m^{-1} using the Harwell 15 Mev linear accelerator and time-of-flight spectrometer. "Area" and, in some cases, "shape" analyses of the data were made to determine values of the peak total cross sections σ_0 and the total widths Γ of twelve resonances. Assuming a constant radiation width of approximately 0.07 ev the following values were obtained for the spins J of resonances formed in the compound nucleus $W^{183} + n$: $J = 1$ for the 27.17 and 46.08 ev resonances and $J = 0$ for the 47.74, 100.8, 144, and 174 ev resonances. Estimates of the neutron strength functions for the two spin states 0 and 1 are given. Resonances observed at 100.8, 101.5, 103.7, 154.5, 155.2, 156.7, and 192 ev were not resolved previously. (auth)

950

SPINS AND RADIATION WIDTHS OF THE LOW ENERGY NEUTRON RESONANCES IN TUNGSTEN. J. R. Waters, J. E. Evans, B. B. Kinsey, and G. H. Williams (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Phys. 12, 563-78(1959) Sept. (1).

Measurements were made of the parameters of nine low energy neutron resonances in tungsten. The results from neutron transmission, elastic scattering, and capture γ-ray experiments were combined to obtain accurate values for the neutron and radiation widths, and, for W^{183}, of the spins of the excited levels. For W^{183} the resonances at 7.62, 27.1, 46.1, 47.7, and 100.8 ev were found to have spin 1, 1, 1, 0, and 0, respectively. The average value for the radiation widths for the levels with spin 0 and spin 1 were the same within the experimental error. For the three tungsten isotopes 182, 183, and 186 the average radiation widths were 50 ± 4, 73 ± 4, and 45 ± 6 Mev, respectively. These values do not agree with the observation that the average radiation widths are roughly proportional to the fourth power of the binding energy. (auth)

951

INELASTIC SCATTERING OF HIGH ENERGY PROTONS BY HELIUM: AN EXCITED LEVEL? Peter Hillman, Arne Johansson, Gunnar Tibell, and Helge Tyrén (Univ. of Uppsala) and H. S. Köhler (CERN, Geneva). Nuclear Phys. 12, 596-605(1959) Sept. (1).

No clear evidence for the existence of an excited level was found in an investigation of the energy spectra and polarizations of 185 Mev protons inelastically scattered by He^4 in the angular region 6.5° to 43.5°$_{lab}$. An upper limit of 0.02 mb $\times$ sr^{-1}$_{c.m.}$ was obtained for the excitation of an excited level in the region 4 to 17 Mev excitation energy in 33.5°$_{lab}$ scattering of these protons. A peak in the energy spectra is seen at all angles at 22.5 ± 0.4 Mev excitation energy, which is quite well fitted with a simple model of quasi-free nucleon-nucleon scattering with a final state interaction for which the parameter values required, however, seem anomalous. (auth)

952

PHENOMENOLOGICAL TWO-NUCLEON POTENTIALS

AND THE DEUTERON. II. K. V. Laurikainen and O. Varho (Univ. of Turku, Finland). Nuclear Phys. 12, 606–11(1959) Sept. (1).

The ground state of the deuteron corresponding to Gammel and Thaler's potential was investigated by numerical integration. There exists no exact ground state in the neighborhood of the right binding energy. An approximate ground state wave function was tabulated and the corresponding electromagnetic properties of the deuteron were studied, including the correction to the magnetic moment due to the LS-potential. (auth)

953

MULTIPOLARITIES OF U^{233} TRANSITIONS. K. Maack Bisgård, P. Dahl, and K. Olesen (Univ. of Aarhus, Denmark). Nuclear Phys. 12, 612–18(1959) Sept. (1).

Multipolarities for twelve gamma transitions in the beta decay of Pa^{233} were determined on the basis of relative conversion coefficients measured with a six gap spectrometer. Spin and parity were assigned to all corresponding levels in U^{233}. Some conversion line interpretations differ from those of previous authors and a few formerly unreported electron lines were observed. (auth)

954

ENERGY LEVELS OF Na^{22} FROM THE $Mg^{24}(d,\alpha)Na^{22}$ AND $Mg^{25}(p,\alpha)Na^{22}$ REACTIONS. Cornelius P. Browne (Univ. of Notre Dame, Ind.). Nuclear Phys. 12, 662–71 (1959) Sept. (1).

Energy levels of Na^{22} were observed with the $Mg^{24}(d,\alpha)Na^{22}$ and $Mg^{25}(p,\alpha)Na^{22}$ reactions. Bombarding energies in the range of 5.0 to 7.5 Mev were used, and the alpha particles were recorded with a broad-range spectrograph. Ground state Q-values are 1.954 ± 0.007 Mev for the first and -3.153 Mev for the second reaction. Excited states, presumably with isobaric spin zero, were found at 0.585, 0.893, 1.533, 1.944, 1.990, 2.219, 2.576, 2.975, 3.066, 3.526, 3.713 ± 0.008, 3.949, 4.323 ± 0.008, and 4.472 ± 0.008 Mev (all ± 0.005 except where shown otherwise) using the (d, α) reaction. The first and second of these were also seen through the (p, α) reaction and, in addition, a $T = 1$ state at 0.661 ± 0.008 Mev. The ground state Q-value for the $N^{14}(p, \alpha)$ C^{11} reaction was found to be -2.928 Mev. (auth)

955

THE LEVEL SCHEME OF ^{134}Ba. SOME FEATURES OF THE NaI SUMMING SPECTROMETER. R. K. Girgis and R. Van Lieshout (Instituut voor Kernphysisch Onderzoek, Amsterdam). Nuclear Phys. 12, 672–88(1959) Sept. (1).

A detailed analysis of the gamma ray spectrum from Cs^{134} was performed. The results are in agreement with previous measurements, but two additional weak gamma rays of 960 and 1570 kev were found. Summing peaks of 1.17, 1.40, 1.57, 1.64, 1.77, and 1.97 Mev were observed, establishing the presence of levels of these energies in Ba^{134}. The gamma ray spectrum from the decay of La^{134} was also examined. Only one gamma ray of 605 kev was observed, thus confirming that the first 2^{+} level in Ba^{134} has this energy. Some features of the NaI summing spectrometer are demonstrated and discussed. (auth)

956

THEORETICAL CALCULATIONS ON $\mu^{-} + {}^{12}C \rightarrow {}^{12}B + \nu$. L. Wolfenstein (Carnegie Inst. of Tech., Pittsburgh). Nuovo cimento (10) 13, 319–25(1959) July 16.

Theoretical calculations of the capture rate and possible observations on the recoiling nucleus were made for the process $\mu^{-} + C^{12} \rightarrow B^{12} + \nu$. The basic interaction

for μ-meson capture is assumed to be the same as that in β decay. Virtual pion effects which are included with and without the assumption of a conserved vector current, are difficult to observe because of the theoretical uncertainty as to the magnitude of the second forbidden contributions. (auth)

957

n,p AND n,np REACTIONS WITH 14 Mev NEUTRONS. L. Colli (Laboratori CISE, Milan and Università, Milan); U. Facchini (Laboratori CISE, Milan and Università, Turin); and I. Iori, M. G. Marcazzan, and A. M. Sona (Laboratori CISE, Milan). Nuovo cimento (10) 13, 730–60(1959) Aug. 16.

Measurements of the energy spectra of protons emitted in (n,p) and (n,np) reactions with 14 Mev neutrons are described. The spectra are taken at four different angles in the case of Ni, Cu, Mo, and Ag. The results are compared with other results in the domain of the nuclear reactions at intermediate energy. The mechanism of instantaneous effects results in the forward emitted high energy particles. The mechanism of non equilibrium escape is responsible for the main part of the spectra and for emission at any angle. The escape is supposed to be due to the strong interactions between few excited nucleons at the nuclear surface. The mechanism of retarded emission, probably after stabilized equilibrium is reached, will explain the emission of protons by medium A nuclei and of neutrons when incident energy is below 18 Mev. Values of temperatures of ~ 1 Mev are found. In (n,2n) and (n,np) reactions strong emission of protons competes in some cases with neutron emissions. The role of surface conditions in this retarded emission is enlightened. (auth)

958

(n,d) REACTIONS WITH 14 Mev NEUTRON ENERGY. L. Colli (Università, Milan and Laboratori CISE, Milan) and F. Cvelbar, S. Micheletti, and M. Pignanalli (Università, Milan and Istituto Nazionale di Fisica Nucleare, Milan). Nuovo cimento (10) 13, 868–70(1959) Aug. 16.

The deuteron cross sections and spectrum for the (n,d) reaction at 14 Mev were measured for P^{31} and S^{32}. An intense deuteron line corresponding to the fundamental state of the residual nucleus was observed, corresponding to the excited levels 1.26 and 2.23 Mev in S^{32} and at 3.1 Mev in P^{31}. Both reactions have the last proton on an s level, giving origin to a pick-up reaction with an $l = 0$ transition allowed. (C.J.G.)

959

ULTRASONIC INVESTIGATION OF NUCLEAR SPIN-LATTICE RELAXATION. G. S. Verma (Univ. of Allahabad, India and Western Reserve Univ., Cleveland). Nuovo cimento (10) 13, Suppl. No. 1, 41–62(1959).

Various theories connected with ultrasonic investigations of nuclear spin-lattice relaxation are presented. The effects of covalency on electrostatic interaction energy of a nucleus with the charges constituting its environment are proposed in theoretical calculations. A mathematical treatment is contained on the probability per unit time that sound waves will produce a transition of a nuclear spin between its Zeeman levels. Expressions are also presented on equilibrium nuclear magnetization in the presence of ultrasonic and thermal lattice vibrations. Experimental ultrasonic techniques based on the pulsed nuclear induction method of measuring nuclear magnetization are described. (C.J.G.)

760

THE REACTION $^7Li(\alpha\gamma)^{11}B$. G. A. Jones, C. M. P. Johnson, and D. H. Wilkinson (Cavendish Lab., Cambridge, Eng.). Phil. Mag. (8) 4, 796-814(1959) July.

The gamma rays following excitation by the $Li^7(\alpha,\gamma)B^{11}$ reaction of levels in B^{11} at 9.28, 9.19, and 8.93 Mev were studied with sodium iodide scintillation counters and a scintillation pair spectrometer. The decay schemes of these levels were elucidated and angular distributions of some of the gamma rays were measured. From these data, and a consideration of the reaction widths of the levels in B^{11}, assignments of spins and parities were made. In particular it was established that the characteristics of the 4.46 Mev and 9.28 Mev levels in B^{11} are −5/2 and +5/2 respectively, and that the Ml radiation from the 4.46 Mev level is mixed with a small proportion of E2 radiation. (auth)

761

TOTAL PHOTOELECTRIC CROSS SECTIONS OF COPPER, MOLYBDENUM, SILVER, TANTALUM, AND GOLD AT 662 kev. W. F. Titus (National Bureau of Standards, Washington, D. C.). Phys. Rev. 115, 351-6 (1959) July 15.

The total photoelectric cross sections of copper, molybdenum, silver, tantalum, and gold were measured at 662 kev. A highly collimated beam of gammas from a Cs-137 source impinged upon a thin disk of a target material. Photoelectrons from a target were detected by a plastic scintillator subtending very nearly 4π steradians. Pulse-height analysis permitted partial resolution of photoelectric and Compton events. After subtraction of unresolved Compton events and correction for coherent scattering effects, the cross sections were found to be 0.125 ± 0.009, 0.700 ± 0.016, 1.198 ± 0.028, 8.55 ± 0.14, and 11.62 ± 0.16 barns, respectively, in satisfactory agreement with theory. (auth)

762

SPIN-ORBIT CONTRIBUTIONS TO THE H^3-He^3 MAGNETIC MOMENTS. Jay M. Berger (International Business Machines Research Center, Yorktown Heights, N. Y.). Phys. Rev. 115, 384-8(1959) July 15.

The contributions to the magnetic moments of the triton and He^3 from the Signell-Marshak and Gammel-Thaler phenomenological spin-orbit potentials were calculated using the Pease and Feshbach wave functions. The results indicate that the isotopic spin dependence of the spin-orbit potential should be of the form $(3 + \tau_i \cdot \tau_j)$ and also that the spin-orbit potential contributions are too small by an order of magnitude to account for the approximately 0.2 nm anomalies in the H^3−He^3 magnetic moments. (auth)

763

SCATTERING OF HIGH-ENERGY NEUTRONS BY He^4. T. W. Bonner, F. W. Prosser, Jr., and J. Slattery (Rice Inst., Houston, Tex.). Phys. Rev. 115, 398-400(1959) July 15.

The scattering of neutrons in He^4 was investigated for neutrons with energies of from 16 to 23.4 Mev with a helium-filled ionization chamber. A pronounced resonance was found at a neutron energy of 22.15 ± 0.12 Mev. This resonance corresponds to an excitation energy in He^5 of 16.72 ± 0.10 Mev which is the same excitation energy as that obtained for the maximum in the $T(d,n)He^4$ cross section. The neutron scattering experiments indicate that the level in He^5 has a width of about 100 kev which is much narrower than the ground state of He^5. This state in He^5 probably has angular momentum and parity of $\frac{3}{2}^+$ and is made up of two neutrons and a proton in the S shell and one proton and one neutron in the P shell. Such a configuration would explain the large deuteron reduced width of the $T(d,n)He^4$ reaction and the small neutron width. (auth)

764

γ-γ ANGULAR CORRELATION MEASUREMENTS OF THERMAL-NEUTRON CAPTURE γ RAYS IN MAGNESIUM, SILICON, PHOSPHORUS, AND SULFUR. G. Manning and G. A. Bartholomew (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Phys. Rev. 115, 401-11(1959) July 15.

A description is given of an angular correlation apparatus, using two NaI (Tl) scintillation spectrometers, which was used to study cascades of γ radiation following thermal neutron capture. The elements studied were magnesium, silicon, phosphorous, and sulfur. The following new spin assignments were made: the 4.93-Mev level of Si^{29}, $\frac{3}{2}$; 6.38-Mev level of Si^{29}, $\frac{1}{2}$; 1.15-Mev level of P^{32}, 1; and 3.26-Mev level of P^{32}, 2. In addition, the spins of the 3.41-Mev level of Mg^{25} and the 3.22-Mev level of S^{33} were confirmed to be $\frac{3}{2}$. Other aspects of the decay schemes are discussed. (auth)

765

DECAY OF Tb^{156} (5-day). Shimon Ofer (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 115, 412-20 (1959) July 15.

Radioactive Tb^{156} (~5-day) was produced by the bombardment of Eu^{153} with α particles. It was found to decay by K capture to Gd^{156}. A decay scheme was proposed which includes the following excited states of Gd^{156}: 89 kev (2+), 289 kev (4+), 581 kev (6+), 1134 kev (2+), 1229 kev (3+), 1489 kev (4+), 1604 and 1904 kev (3), and 2024 kev (4−). The assignments of spins of levels and multipolarities of gamma-ray transitions are based on the results of measurements of conversion coefficients and gamma-gamma angular correlations. A value of $(1.5 \pm 0.3) \times 10^{-10}$sec was found for the mean life of the 289-kev level of Gd^{156}. The level scheme is discussed in the light of the unified model. The results support the suggestion that the 1134 and 1229-kev levels should be interpreted as collective vibrational levels. (auth)

766

PHOTONUCLEAR REACTION ENERGIES. A. S. Penfold and E. L. Garwin (Univ. of Chicago). Phys. Rev. 115, 420-4(1959) July 15.

The general problem of determining photonuclear reaction energies in the region below 25 Mev is discussed, and the need for absolute calibration of betatron energy scales is demonstrated. A system for accomplishing such a calibration is briefly described and the results of some measurements made with it are given. The $Cu^{63}(\gamma,n)Cu^{62}$ threshold was observed to be at 10.78 ± 0.03 Mev, and two well-defined "breaks" in the $O^{16}(\gamma,n)O^{15}$ yield curve are at 16.19 ± 0.04 and 17.25 ± 0.04 Mev. These "breaks" lead to the assignment of energy levels in O^{16} which are in excellent agreement with those observed in the N^{15} (p,n)O^{15} reaction. (auth)

767

RATIOS OF RELATIVE ABUNDANCE, MAGNETIC MOMENTS, AND CAPTURE CROSS SECTIONS OF GADOLINIUM ISOTOPES FROM PARAMAGNETIC RESONANCE SPECTRUM. W. Low (Hebrew Univ., Jerusalem) and D. Shaltiel (Israel Inst. of Tech., Haifa). Phys. Rev. 115, 424-6(1959) July 15.

Precision measurements on the hyperfine structure of the transitions corresponding to $\Delta M = 4$ of the cubic-field paramagnetic resonance spectrum of gadolinium in single crystals of thorium oxide yield the following values of isotopic abundance: even isotopes, 69.45%; Gd^{155}, 15.05 ± 0.2%; Gd^{157}, 15.5 ± 0.2%. Ratio of magnetic moments was reported to be $\mu^{155}/\mu^{157} = 0.7495 \pm 0.0045$. Irradiation of crystals at the Harwell pile with a thermal neutron flux of 1.2×10^{12} n/cm^2 sec, and a fast flux of 2.3×10^{11} n/cm^2 sec, yields the ratio of nuclear capture cross sections $\sigma^{157}/\sigma^{155} = 2.82$, using the above abundance values. No F-center spectrum was detected in crystals irradiated with a total neutron flux of about 10^{18} n/cm^2. The paramagnetic resonance spectrum of gadolinium in irradiated crystals is unchanged, indicating negligible radiation damage in the neighborhood of the paramagnetic ions. (auth)

960

SINGLE-PARTICLE STATES OF THE NEUTRON FROM GROSS STRUCTURE IN THE PROTON SPECTRA OF (d,p) REACTIONS. J. P. Schiffer, L. L. Lee, Jr., and B. Zeidman (Argonne National Lab., Lemont, Ill.). Phys. Rev. 115, 427-34(1959) July 15.

Systematic gross-structure peaks were observed in the proton spectra from (d,p) reactions on nuclei in the region of atomic weight 60. Measurements at deuteron energies of 4, 10, and 21.6 Mev were made with the energy resolution in the proton detectors considerably worse than the known spacing of levels in these nuclei. In all these measurements, the peaks in the proton spectra stayed at a fixed energy of the captured neutron. Angular distributions obtained with 10-Mev deuterons were analyzed in terms of the Butler theory of stripping reactions. It was found that each peak in the proton spectrum corresponded to a specific value of the orbital angular momentum of the captured neutron. The peaks are interpreted as being caused by the shell-model single-particle states of the captured neutron, when these states are smeared out among the many actual levels of the nucleus. Thus the observed gross-structure peaks are believed to correspond to the giant resonances of the complex-potential model of Feshbach Porter, and Weisskopf. Peaks were assigned to the $1f_{7/2}$, $2p_{3/2}$, $1f_{5/2}$, $2p_{1/2}$, $1g_{9/2}$, $2d_{5/2}$, $3s_{1/2}$, and $2d_{3/2}$ shell-model states, although these states could not all be identified in every nucleus that was studied. The relative intensities of the peaks are also consistent with this interpretation, except for the $l = 0$ peaks at high excitation energies. Information on the ground-state configurations of the target nuclei was also obtained from the intensities. (auth)

965

NUCLEAR STATES IN THE RaE β-DECAY. Neal Newby, Jr. and E. J. Konopinski (Indiana Univ., Bloomington). Phys. Rev. 115, 434-44(1959) July 15.

It is shown that the β-transforming neutron of Bi^{210} most probably has an $i_{11/2}$ character, despite a $g_{9/2}$ character of the ground-state neutron in Pb^{200}. This makes a critical difference to the RaE spectrum parameter, $\xi = i(r)/(\sigma \times r)$, yielding $\xi \approx +1$ rather than $\xi \approx -1/10$. The effect of configuration mixing is also investigated but does not affect ξ appreciably. The conclusion is that the two-body neutron-proton force may be well represented by zero-range forces of the same volume energy as found experimentally. Tensor effects vanish identically in this limit and so an unambiguous representation of the strength can be obtained. The results

for the relative positions of the $J = 0$ and 1 states, used as the test above, now turn out in almost perfect agreement with the observations. Configuration mixing plays a role in this result, and, in consequence, the work includes a generalization of de-Shalit's formulas, for the interaction energies with zero-range forces, to nondiagonal matrix elements. (auth)

970

GAMMA RAYS FROM Si^{29} + p. J. H. Singh (Univ. of Kansas, Lawrence). Phys. Rev. 115, 445-7(1959) July 15.

Gamma rays from the reaction $Si^{29}(p,\gamma)$ were investigated at five resonances at proton energies of 414, 696, 737, 916, and 956 kev. Experimental evidence indicating two close-lying levels at about 700 kev above the ground state is presented. (auth)

971

DECAY OF $_{62}Sm^{155}$ (23.5 min). L. C. Schmid and S. B. Burson (Argonne National Lab., Lemont, Ill.). Phys. Rev. 115, 447-9(1959) July 15.

The decay of Sm^{155}(23.5 min) is characterized by beta emission to excited states in Eu^{155}. This activity was studied by means of the Argonne 256-channel scintillation coincidence spectrometer. Sources were prepared by neutron irradiation of samarium oxide, enriched in Sm^{154}, in the Argonne reactor CP-5. Three gamma-ray transitions and two beta-ray branches are reported. These radiations are fitted into a decay scheme which indicates the presence of excited states in Eu^{155} at 105 and 246 kev. The total decay energy is found to be 1.8 ± 0.1 Mev. Possible spin and parity assignments for each of the levels are discussed. (auth)

972

BETA DECAY ENERGY OF TRITIUM. Fred T. Porter (Argonne National Lab., Lemont, Ill.). Phys. Rev. 115, 450-3(1959) July 15.

The extrapolated end point from Kurie plots of the tritium beta spectrum between 14 and 18 kev was measured as 18.61 ± 0.02 kev (internal consistency) on the Argonne double-lens beta spectrometer. Composite sources of tritiated estradiol and 10-hr thorium B (Pb^{212}) and its daughters allow calibration at 25 kev (the "A" line) as well as some check on the effect of the source thickness on the "A" line. A review of other measurements, including mass difference data, average energy determination, and proportional counter work, shows agreement with the present magnetic spectrometer result, 18.6 ± 0.1 kev (this error includes some estimate of possible systematic effects). Two notable exceptions give lower values, 18.2 and 18.0 kev, one an average energy determination, and the other a magnetic spectrometer result. The 18.6-kev decay energy and a half-life of 12.43 years give ft = 1137 ± 20 sec. (auth)

973

MAGNETIC MOMENTS OF STRONGLY DEFORMED ODD-ODD NUCLEI. W. M. Hooke (Princeton Univ., N. J.). Phys. Rev. 115, 453-6(1959) July 15.

The strong-coupling magnetic moment relation for odd-odd nuclei is evaluated with the use of Nilsson wave functions for finite values of core distortion. The theoretical predictions are compared with all of the data available on odd-odd nuclei in the strong-coupling region. There is no evidence for appreciable error having been introduced by the assumption of no interaction between the odd proton and odd neutron. (auth)

974

DISPERSIVE EFFECTS IN ELECTRON-NUCLEUS INTERACTIONS. Nicholas A. Krall and E. E. Salpeter (Cornell Univ., Ithaca, N. Y.). Phys. Rev. 115, 457-63 (1959) July 15.

Elastic scattering of electrons from nuclei is influenced by the possibility of virtual transitions to excited nuclear states in intermediate states. Such dispersive corrections to electron-deuteron elastic scattering are calculated in second order Born approximation for incident electron energies from 200 to 500 Mev for various values of the momentum transfer. The static second-order Born formulas are also evaluated. Similar, but less accurate, calculations are carried out for He^4, C^{12}, and some heavier elements. These results are used to find small corrections to nuclear radii obtained from an analysis of the Stanford experiments. Dispersive effects on the energy level shifts in bound s states of hydrogenic atoms are calculated, using second-order perturbation theory for the deviation of the nuclear charge distribution from a point charge. These small shifts are evaluated for deuterium and He^4 and, less accurately, for other nuclei with Z < 50. (auth)

975

LOW-ENERGY ANTIPROTON INTERACTIONS IN HYDROGEN AND DEUTERIUM. Nahmin Horwitz, Donald Miller, Joseph Murray, and Robert Tripp (Univ. of California, Berkeley). Phys. Rev. 115, 472-7(1959) July 15.

The distributions of charged particles resulting from antiproton annihilations in hydrogen and deuterium are compared with the predictions resulting from the "normalized" statistical theory of Fermi. Multiplicities and momentum distributions are shown to be in agreement with the theory if the radius of the interaction volume is chosen to be about 3×10^{-13} cm. The values given for the average multiplicities observed in hydrogen and deuterium are 4.94 ± 0.31 and 5.03 ± 0.44, respectively, both somewhat lower than found in the emulsion experiments. K-meson production in annihilations was found to be consistent with previous experiments, but the number of events is statistically inadequate to warrant any new conclusions. The total elastic scattering cross sections in hydrogen, though of small statistical significance, are in agreement with recent theoretical calculations. (auth)

976

He^3- AND He^4-INDUCED COULOMB EXCITATION. D. A. Bromley, J. A. Kuehner, and E. Almqvist (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev. 115, 586-98(1959) Aug. 1.

In order to examine the characteristics of the He^3-induced Coulomb excitation process and the validity of the cross-section ratio technique for the identification of both E1 and E2 transitions, thick-target radiation yield ratios were measured for He^3- and He^4-induced Coulomb excitation of each of the 110- and 197-kev levels of F^{19}, the 446-kev level of Na^{23}, the 160-kev level of Ti^{47}, and the 126-kev level of Mn^{55} at corresponding (equal ξ) energies. For the E2 transitions a mean ratio of the He^3- to He^4-induced yields of 0.63 ± 0.02 was found, independent of incident energy in the range 1.0 to 2.5 Mev, in agreement with the calculated value of 0.64 for F^{19} and Na^{23} and of 0.63 for Ti^{47} and Mn^{55}. In the single E1 transition (110 kev in F^{19}) studied, the experimental ratios range from 0.76 ± 0.07

at $E_{He^3} = 1.00$ Mev to 0.59 ± 0.11 at $E_{He^3} = 1.75$ Mev. While in accord with the theoretical prediction of 0.76 at the lower energies, the indicated energy dependence of the ratio is suggestive of contributions due to nuclear inelastic scattering of alpha particles. It was demonstrated that the ratio technique, using He^3 and He^4 ions, provides an unambiguous multipolarity determination provided that inelastic-scattering contributions can be excluded. (auth)

977

ELASTIC SCATTERING AND POLARIZATION OF PROTONS BY HELIUM AT 147 AND 66 MEV. A. M. Cormack, J. N. Palmieri, N. F. Ramsey, and Richard Wilson (Harvard Univ., Cambridge, Mass.). Phys. Rev. 115, 599-608(1959) Aug. 1.

Measurements were made of the polarization and differential cross section in elastic p-α scattering at 147 and 66 Mev, in the laboratory angular ranges of 2 to 165° and 10 to 45°, respectively. These measurements were compared with recent calculations which relate the scattering amplitudes to nucleon-nucleon results. Because these calculations take into account the angular variation of the nucleon-nucleon amplitudes, better agreement is obtained than heretofore. A comparison of the polarization with that observed in inelastic scattering from several levels of a variety of spin-zero nuclei indicates a strong similarity between the elastic and inelastic data, which can be explained theoretically. (auth)

978

ANGULAR CORRELATION MEASUREMENTS IN O^{15}. B. Povh and D. F. Hebbard (California Inst. of Tech., Pasadena). Phys. Rev. 115, 608-13(1959) Aug. 1.

An accurate measurement of the energy of a gamma transition from the 7.56-Mev level in O^{15} discloses that the transition takes place to the 5.19-Mev level in O^{15} rather than to the 5.25-Mev level. Another transition takes place through the 6.15-Mev level. The third known transition occurs through the 6.79-Mev level rather than through the 6.86-Mev level. The angular correlations of cascades from the 7.56-Mev level through the levels at 6.79, 6.15, and 5.19 Mev are measured. These results, combined with previous results on these levels, are consistent only with $J^\pi = \frac{3}{2}^+$ and $\frac{3}{2}^-$, respectively, for the 6.79- and 6.15-Mev levels. For the 5.19-Mev level, the present results indicate $J = \frac{1}{2}$, but are consistent also with $J = \frac{3}{2}$, if a suitable mixing ratio of E2 to M1 radiation is chosen. The preferred assignments are all consistent with the shell-model predictions and with comparisons with the N^{15} level scheme. It is noted that the doublets near 5.2 Mev in O^{15} and N^{15} are reversed in order. (auth)

979

NUCLEAR SPINS OF SILVER-104 AND SILVER-106. W. B. Ewbank, L. L. Marino, W. A. Nierenberg, H. A. Shugart, and H. B. Silsbee (Univ. of California, Berkeley). Phys. Rev. 115, 614-18(1959) Aug. 1.

The nuclear spins of four neutron-deficient isotopes of silver were measured by atomic-beam methods. The results are: for 27-min Ag^{104}, I = 2; for 1.2-hr Ag^{104}, I = 5; for 24-min Ag^{106}, I = 1; and for 8.3-day Ag^{106}, I = 6. Of these, the result for 1.2-hr Ag^{104} has not been reported previously. (auth)

980

ELASTIC SCATTERING AND CAPTURE OF PROTONS BY C^{14}. D. F. Hebbard (California Inst. of Tech.,

Pasadena) and D. N. F. Dunbar (Univ. of Melbourne). Phys. Rev. 115, 624-32(1959) Aug. 1.

The reaction $C^{14}(p,p)$ was investigated over the energy range from 340 to 690 kev. No wide anomalies are found, but a narrow anomaly at 527 kev was attributed to d-wave protons forming a state of spin $\frac{3}{2}^{+}$. The reaction $C^{14}(p,\gamma)$, investigated over the range from 250 to 690 kev, shows a resonance at 261 kev in addition to the three previously known resonances at 351, 527, and 634 kev. Proton and radiative widths are obtained for all these resonances, and limits are placed on the spin assignments. From the data obtained, it is clear that the levels corresponding to the resonances at proton energies of 261, 351, and 527 kev cannot contribute significantly to the scattering or capture of low-energy neutrons by N^{14}. In addition, the level corresponding to the 634-kev resonance cannot be responsible for the whole of the $N^{14} + n$ cross section at low energies, but it may be responsible for part of this cross section. It is suggested that the level at 9.84 Mev is responsible for the remainder of this cross section. A good fit to the neutron elastic scattering cross section is obtained over the neutron energy range from 0 to 600 kev. (auth)

781

SIGN OF g IN MAGNETIC RESONANCE, AND THE SIGN OF THE QUADRUPOLE MOMENT OF Np^{237}. M. H. L. Pryce (Univ. of Bristol, Eng.). Phys. Rev. Letters 3, 375(1959) Oct. 15.

The magnetic moment of Np^{237} is deduced from magnetic resonance to be negative. This is in accordance with the deduction from the emission of particles from oriented Np^{237} nuclei. (W.D.M.)

782

FLUCTUATIONS IN PARTIAL RADIATION WIDTHS. L. M. Bollinger, R. E. Coté, and T. J. Kennett (Argonne National Lab., Lemont, Ill.). Phys. Rev. Letters 3, 376-8(1959) Oct. 15.

One of the main efforts of slow-neutron spectroscopy has been to measure and interpret the distribution of partial widths for elastic scattering, radiative capture, and fission in neutron resonances. The ability to measure the partial widths for individual radiative transitions has resulted from improvement in experimental techniques. An experiment is described in which an attempt was made to observe the high energy end of resonant-capture gamma spectra of W^{183}, Pt^{195}, and Hg^{199} in enough detail to be able to determine the probabilities of transitions not only to the ground state but also to one or more of the low-energy states of the compound nucleus. (W.D.M.)

783

ELECTRON CAPTURE DECAY OF ORIENTED NUCLEI. Adrian Gelberg (Inst. of Atomic Physics, Bucharest). Phys. Rev. Letters 3, 378-80(1959) Oct. 15.

Recent developments in the theory of beta decay have suggested new types of experiments which might yield information concerning the beta decay interaction. An experiment with oriented nuclei is proposed, the results of which should enable one to make a choice between the ST and VA variants. Detection of resonant scattering of the gamma rays emitted after the decay should yield some information about the recoil direction of the nucleus. (W.D.M.)

784

COSMIC-RAY-PRODUCED Si^{32} IN NATURE. Devendra Lal, Edward D. Goldberg, and Minoru Koide (Scripps

Institution of Oceanography, La Jolla, Calif.). Phys. Rev. Letters 3, 380(1959) Oct. 15.

The radioisotope Si^{32}, expected to be produced in the nuclear spallations of atmospheric argon by cosmic rays, has been detected in the marine environment. Its half life is approximately 700 years. The global production rate is calculated to be 2.0×10^{-4} Si^{32} atoms/cm^{2} sec. The corresponding inventory of Si^{32} on earth is 28 kilocuries or 1.75 kg (principal reservoir being the marine hydrosphere). Sponges which lay down an opaline (SiO_2) skeleton derived from the silica in marine waters provide a truly natural means of concentration. (W.D.M.)

785

NUCLEAR RESONANCE FLUORESCENCE WITH SOLID SOURCES: Mg^{24}, Si^{28}, Cr^{52}, Sr^{88}, AND Ce^{140}. S. Ofer and A. Schwarzschild (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters 3, 384-6(1959) Oct. 15.

The nuclear resonance fluorescence technique is well suited in many cases for the determination of short lives ($\tau < 10^{-12}$ sec) of highly excited states, where most other techniques fail. The lifetimes of the first excited 2+ states of the even-even nuclei Mg^{24}, Si^{28}, Cr^{52}, Sr^{88}, and Ce^{140} were measured using the method of self-absorption of resonantly scattered rays. All the measurements were performed using solid or liquid sources at room temperature. (W.D.M.)

786

CONFIGURATIONAL ASSIGNMENTS OF GIANT PHOTONUCLEAR RESONANCES. D. H. Wilkinson (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters 3, 388-9(1959) Oct. 15.

It is pointed out that the configurational assignments made by the independent-particle model (IPM) for the giant resonance rest on rather general grounds and that the conclusion to be drawn from (d,p) gross structure results is not simple. The essential correctness of the IPM configurational assignments depends only on (i) the approximate validity of the IPM description of the ground state and (ii) the fact that the giant resonance approximately exhausts the electric dipole sum. (W.D.M.)

787

DOUBLE-HYPERFRAGMENT EVENT. D. H. Wilkinson, S. J. St. Lorant, D. K. Robinson, and S. Lokanathan (Clarendon Lab., Oxford). Phys. Rev. Letters 3, 397-8 (1959) Oct. 15.

A star found in Ilford G-5 nuclear emulsion irradiated by 4.5-Bev/c π^{-}-mesons from the Bevatron is illustrated and explained. One particle is a uniquely identified $_{\Lambda}H^{4}$ with $B_{\Lambda} = 2.29 \pm 0.61$ Mev, and the other can be satisfactorily analyzed as $_{\Lambda}H^{4}$ or $_{\Lambda}Li^{8,9}$, with other possibilities remote. (W.D.M.)

788

POLARIZATION MEASUREMENTS OF PROTON CAPTURE GAMMA RAYS. M. Suffert, P. M. Endt, and A. M. Hoogenboom (Rijksuniversiteit, Utrecht). Physica 25, 659-70(1959) Aug.

The linear polarization of eight different gamma rays of widely differing energies ($E_\gamma = 0.8 - 8.0$ Mev) emitted at resonances in the $Mg^{24}(p,\gamma)Al^{25}$, $Si^{30}(p,\gamma)P^{31}$, and $S^{32}(p,\gamma)Cl^{33}$ reactions were measured. The gamma rays emitted at 90° to the proton beam were Compton scattered in a NaI crystal and then detected in two scintillation counters. The 2.65 and 2.86 Mev levels in Cl^{33} have $J^{\pi} = \frac{5}{2}^{+}$ and $\frac{3}{2}^{-}$, respectively. The 2.69 and 2.24

Mev gamma rays observed at the 418 kev $Mg^{24}(p,\gamma)Al^{25}$ resonance, and the 2.85 Mev gamma ray at the 580 kev $S^{32}(p,\gamma)Cl^{33}$ resonance have predominantly M1 character, while the 8.04 Mev gamma ray at the 776 kev $Si^{30}(p,\gamma)P^{31}$ reaction has predominantly E2 character. For the two remaining gamma rays the measured polarizations were in agreement with known nuclear data. (auth)

789

ANGULAR DISTRIBUTION AND LINEAR POLARIZATION OF GAMMA RAYS FROM ALIGNED ^{166m}Ho NUCLEI. H. Postma, A. R. Miedema, and M. C. Eversdijk Smulders (Kamerlingh Onnes Laboratorium, Leiden). Physica 25, 671–87(1959) Aug.

Measurements of the anisotropies and the linear polarization of γ-radiations from Ho^{166m} oriented in Nd-ethyl-sulphate are reported and discussed. The measurements give information about the multipole order of the γ-rays, the mixing ratio of two multipoles and the electric or magnetic character of the radiations. The 817 and 706 kev γ-rays are found to be nearly pure E2 and E1 radiations and the spins and parities of their initial levels (973 and 1790 kev) are 5– and 6–. The 1256 kev level has probably spin and parity 5–. The hfs constant A/k and the magnetic moment μ of Ho^{166m} are $0.27 \pm 0.03°K$ and 3.2 ± 0.5 nm if the spin I_0 of Ho^{166m} is 6. With $I_0 = 7$ or $I_0 = 8$ the values are $0.24 \pm 0.02°K$ and 3.3 ± 0.5 nm or $0.22 \pm 0.02°K$ and 3.5 ± 0.5 nm respectively. (auth)

790

ON THE DECAY OF ^{74}As. R. K. Girgis and R. Van Lieshout (Instituut voor Kernphysisch Onderzoek, Amsterdam). Physica 25, 688–93(1959) Aug.

The gamma spectrum of As^{74} was studied with a scintillation spectrometer. In addition to gamma rays of 600 and 635 kev, others of 0.88, 1.00, 1.20, and very weak ones of 1.61, 1.84, and 2.20 Mev were found. A level scheme is proposed for Ge^{74} with levels at $0.600 (2^+)$, $1.20 (2^+)$, and 2.20 Mev, and a probable one at 1.48 Mev. (auth)

791

ON THE DECAY OF ^{74}Ga. C. Ythier (Universite, Strasbourg) and W. Schoo, B. L. Schram, H. L. Polak, R. K. Girgis, R. A. Ricci, and R. Van Lieshout (Instituut voor Kernphysisch Onderzoek, Amsterdam). Physica 25, 694–702(1959) Aug.

The beta and gamma radiation from the decay of 8 minute Ga^{74}, produced by fast neutron bombardment of natural germanium and by deuteron bombardment of enriched Ge^{76}, was studied by means of scintillation techniques. In addition to very strong gamma rays of 0.600 and 2.35 Mev, five relatively strong gamma rays of 0.865, 1.02, 1.20, 1.45, and 1.96 Mev, and eleven weaker transitions were observed. Two beta ray branches could be resolved with maximum energies of 2.7 and 4.3 Mev. Some speculations are made about a possible level scheme for Ge^{74}. (auth)

792

CHARACTERIZATION OF THE 10 HOUR ^{196}Au ISOMER. R. Van Lieshout, R. K. Girgis, R. A. Ricci, and A. H. Wapstra (Instituut voor Kernphysisch Onderzoek, Amsterdam) and C. Ythier (Université, Strasbourg). Physica 25, 703–7(1959) Aug.

The Au^{196} isomer was found to decay with a half life of 10.0 ± 0.5 hours. Scintillation spectrometer and beta ray spectrometer studies show the existence of four transitions. The half life is governed by an M4 isomeric transition of 176 ± 2 kev which is followed by two

gamma rays of 149 ± 2 and 186 ± 2 kev in cascade; a transition of 84 ± 2 kev is probably in cascade with the other transitions. (auth)

793

THE EFFECT OF POLARIZATION ON THE ELASTIC SCATTERING OF POSITRONS BY HYDROGEN ATOMS. A. H. Moussa (University Coll., London). Proc. Phys. Soc. (London) 74, 101–4(1959) July.

The Hulthén and Kohn variational methods are applied to a further consideration of the effect of polarization in the scattering of slow positrons by hydrogen atoms. A trial function is used which allows for virtual positronium formation. Although the results indicate a greater effect of polarization than those of previous calculations using a mathematically simpler but physically less appropriate trial function, the effect is much less than seems to be required from the experimental results on the scattering of slow positrons by rare gas atoms. (auth)

794

THE β-DECAY OF ^{239}Np. R. D. Connor and I. L. Fairweather (The University, Edinburgh). Proc. Phys. Soc (London) 74, 161–9(1959) Aug.

The β-spectrum of Np^{239} has been examined using a prolate spheroidal magnetic spectrometer of resolution 2% and transmission 5%, and partial spectra observed having the following end-point energies and intensities: 713 kev (6.5%), 654 kev (4%), 437 kev (48%), 393 kev (13.5%), 332 kev (28%). The half life is found to be 2.34 ± 0.02 days and the total disintegration energy = 724 ± 3 kev. The observations confirm the level scheme proposed by Hollander, and the possibility of a β-transition of end-point energy less than 100 kev as proposed by Baranov and Shlyagin is examined. The $\log_{10}$ ft values of the partial spectra and the nature of the γ-transitions are discussed in the light of the asymptotic selection rules. (auth)

795

AN INVESTIGATION OF THE PROTONS, DEUTERONS, AND TRITONS FROM THE BOMBARDMENT OF ^{9}Be WITH 5.7 MeV ^{3}He. S. Hinds and R. Middleton (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Proc. Phys. Soc. (London) 74, 196–207(1959) Aug.

A thin beryllium target has been bombarded by 5.7 Mev He^3 particles and the charged reaction products analyzed with a high precision broad-range magnetic spectrograph. Angular distributions of nine proton groups, four deuteron groups and a single triton group have been measured. Most angular distributions exhibit strong forward maxima suggesting that the reactions, at least in part, proceed via a direct process. (auth)

796

THE COINCIDENCE METHOD. ITS APPLICATION TO THE STUDY OF BETA DECAY SCHEMES. Carlos Alberto Mallmann (Comisión Nacional de Energía Atómica, Buenos Aires, Argentina). Publs. com. nacl. energía atómica (Buenos Aires) Ser. fís. 1, No. 1, 3–35 (1953). (In Spanish)

The possibilities of the coincidence method using coincidence beta ray spectrometers for the investigation of disintegration schemes of beta emitters are given. It is proved that the experimental set up must fulfill certain conditions. The coincidence beta-ray spectrometers must have independent energy measurement in the counter-spectrometer systems, big gathering power and good resolving power in the counter-spectrometer

systems, the possibility of reducing to a negligible value with absorbing materials, the counts produced by gamma rays, an optimum location of the counters to make negligible the cosmic rays coincidence counts, the counter outside of the magnetic field, and the possibility of observing angular correlation. The coincidence equipment must have the resolving time as small as possible. The radioactive specimen must have optimum intensity. (auth)

997

A NEW SERIES OF ISOBARS OF TIN—ANTIMONY. I. G. de Fraenz, J. Rodriguez, and H. Carminatti (Comisión Nacional de Energía Atómica, Buenos Aires). Publs. com. nacl. energía atómica (Buenos Aires) Ser quim. 1, No. 2, 11-18(1955). (In Spanish)

A new tin isotope was found as fission product of uranium, irradiated with deuterons. Its half-life of 57 ± 2 minutes was determined by separations at intervals of its daughter substance. The half-life of the daughter, an antimonium isotope, was measured as 10.3 ± 0.3 minutes and its maximum β energy about 2.9 Mev. (auth)

998

GAMMA RADIATION FROM PROTON CAPTURE IN ALUMINIUM AT THE 991 KeV RESONANCE. Marten Brenner. Soc. Sci. Fennica, Commentationes Phys. Math. 23, No. 5, 1-34(1959).

The energies and relative intensities of gamma rays, resulting from proton capture in aluminum, have been measured at the 991 kev resonance. Radiation of energies 12.6, 10.8, 8.04, 6.07, 4.66, 2.86, and 1.8 Mev has been observed and explained in terms of a level scheme for Si^{28}. Two other rays observed in the spectrum could not be explained by means of the proposed scheme. The angular distribution of the 10.8 Mev radiation, as obtained from the experiment, is compared with the theoretical distribution. The spin assignments of the levels are discussed. An assignment 3^+ or 2^- for the compound state is consistent with the experimental result. (auth)

999

NEWS ON ELEMENT NO. 102. V. I. Gol'danskiĭ. Soviet Phys.—Uspekhi 2, No. 1, 183-6(1959) Jan.-Feb.

Two methods of synthesizing the element nobelium are given. The method of bombarding Pu^{239} and Pu^{240} with oxygen ions at 100 Mev is described. Alpha particles of 8.8 ± 0.5 Mev are reported for 87 cases from the above method. The second method, also based on nuclear-recoil, uses a curium target containing 5% of the isotope Cm^{246} (95% Cm^{244}) which is bombarded with C^{12} ions of 60 to 100 Mev energy. The nobelium atoms produced are slowed down by a helium atmosphere. The half life of No^{254} was determined to be ~3 sec from the above reaction. (C.J.G.)

1000

PHOTOPROTONS FROM VANADIUM. A. Halsteinslid, K. Nybø, and R. B. Møllerud. Univ. i Bergen Årbok, Naturvitenskap. Rekke, No. 15, 1-9(1958).

The angular- and energy distributions of protons from vanadium irradiated by 30 Mev bremsstrahlung have been measured by means of nuclear emulsions. The energy distribution has a maximum at 4 Mev and a similar shape as previously found for medium heavy elements. The medium energy protons show a clear asymmetry in the forward direction. (auth)

1001

THE ENERGY SPECTRUM OF RECOIL NUCLEONS

CAUSED BY SPLITTING OF PHOTOEMULSION NUCLEI. Yu. T. Lukin and Zh. S. Takibaev. Vestnik Akad. Nauk Kazakh. S.S.R., No. 1, 78-85(1959).

The measurement of the intranuclear process resulting in various energy spectra of the secondary particles originated with light and heavy elements of the photoemulsion is treated. The experiments have led to the conclusion that the average energy of the secondary particles, which leave grey traces in the emulsion, decreases with the quantity increase of the greyish black marks in the "center" during the energy interval investigated of the primary particles. The theory of the intranuclear cascade, developed by Messel, does not correspond with the experimental results. (TCO)

Particle Accelerators

1002   CERN-59-31

European Organization for Nuclear Research, Geneva. CLOSED ORBIT ANALYZER. M. Barbier and A. Susini. Aug. 31, 1959. 41p.

If the guiding magnetic field across the vacuum chamber of the P.S. machine would assume, at every instant of the accelerating cycle, the exact values indicated by the theory, the center of mass of the bunch would move along the axis of the vacuum chamber. Guiding magnetic field deviations from the "ideal" values, due to the magnet misalignments, anomalous exciting current deviations, etc., cause the path described by the center of mass of the bunch (the closed orbit) to deviate from the axis of the vacuum chamber, thus increasing the probabilities of losing the beam. Closed orbit deviations, at every instant of the accelerating cycle, are observed and recorded by means of the beam observation system. Utilization of this information, in order to know the location, the amplitude, and the sign of the field perturbations, is performed by the closed orbit analyzer. The device should enable the operator to provide the means for correcting the guiding field perturbations and for keeping the closed orbit at the center of the vacuum chamber. (auth)

1003   CERN-59-32

European Organization for Nuclear Research, Geneva. SURVEY TECHNIQUES FOR ACCELERATORS. B. M. Wheatley. Sept. 2, 1959. 15p.

Radiation survey techniques are described which have been found useful at CERN. Although the 2 CERN machines are permanently shielded, beams are withdrawn from various places through the main shielding, and after passage through the experimental detectors have to be reduced, or preferably stopped, in local shielding arranged temporarily as the need arises. Instruments used in the surveys around the CERN buildings are described. (W.D.M.)

1004   MURA-499

Midwestern Universities Research Assn., Madison, Wis. BACKGROUND IN THE NEIGHBORHOOD OF A COLLIDING BEAM REGION. Don B. Lichtenberg and Lawrence W. Jones. Aug. 26, 1959. 19p. Contract AT(11-1)-384. OTS.

A calculation is made of the number of background events expected in the neighborhood of two colliding proton beams each of energy 10 to 15 Bev. Collisions of each beam with the residual gas in a straight section in the target area and collisions of secondary particles in neighboring iron magnets are roughly taken into account. The calculation breaks down at distances from the beams of the order of the beam diameters. (auth)

1005

THE 225-cm CYCLOTRON AT THE NOBEL INSTITUTE OF PHYSICS, STOCKHOLM. H. Atterling and G. Lindström (Nobel Inst. of Physics, Stockholm). Arkiv Fysik 15, 483-502(1959).

A description is given of the 225 cm fixed-frequency cyclotron at the Nobel Institute of Physics in Stockholm. This cyclotron has operated reliably and stably for several years producing internal beams of protons, deuterons, alpha particles, and heavy ions. The nominal energy attained at a radius of 90 cm with the present oscillator frequency is about 11 Mev per nucleon. So far, internal deuteron beam currents up to approximately 300 μa at a nominal energy of about 22 Mev have been normal. An unusual feature possessed by this cyclotron is the dee biasing system based on the use of condensers as electrical terminations of the dee stems. A description of the system is given. (auth)

1006

THE ACCELERATION OF HEAVY IONS IN THE STOCKHOLM 225-cm CYCLOTRON. Hugo Atterling (Nobel Inst. of Physics, Stockholm). Arkiv Fysik 15, 531-58(1959).

A description is given of the acceleration and bombarding techniques used in the work on heavy ions with the 225 cm cyclotron at the Nobel Institute of Physics, Stockholm. With the present oscillator frequency this machine can accelerate heavy ions with mass-to-charge ratios up to about 3.7. The nominal energy at a radius of 90 cm (exit radius) is about 11 Mev/nucleon. Results of an investigation of the energy distribution of C^{12} beams are reported. It is shown that this distribution contains, together with the high-energy peak of C^{12} ions, a low-energy component. At a radius of 80 cm, where the mean energy for the C^{12} peak is roughly 100 Mev, the low-energy component has a distribution maximum below 30 Mev. (auth)

1007

PROBLEMS IN THE DESIGN OF THE POWER SUPPLY CONVERTER UNIT FOR THE ELECTROMAGNET OF A 10-BILLION ev ACCELERATOR. F. K. Arkhangel'skii. Elektrichestvo No. 1, 10-12(1959).

The problems in the design of a power supply converter for the electromagnet of the synchrophasotron of the Joint Institute of Nuclear Studies are described. A method for the calculation of the components of inductive resistances of the commutation circuit for complicated rectifier connections was devised which gives results which are in agreement with experimental data. (TCO-J.S.R.)

1008

FORMATION OF A BEAM OF RAYS FROM A BETATRON. A. A. Vorob'ev and V. A. Moskalev. Izvest. Vysshikh Ucheb. Zavedeniĭ, Elektromekh. No. 9, 3-5 (1958).

By use of all available data on the distribution of gamma radiation from a 10-Mev betatron, a collimator satisfying certain rigid requirements was constructed. The thickness of a lead collimator necessary to limit the radiation intensity outside the beam to 0.05% of the intensity on the beam axis was calculated to be 15.5 cm. The collimator constructed had a thickness of 17 cm. The details of the construction are shown. The collimator was placed between the coils of the accelerator electromagnet, and it could be adjusted to make the beam and collimator axis coincide. The cross section of the collimated beam could be altered by using inter-

changeable collars or bushings. A conically-shaped copper filter was used to make the intensity of the gamma radiation uniform across the beam. The beam was used to measure the distribution of the isodoses in water. The results of the measurements are shown. A schematic representation of the betatron and the collimator assemblies is given. (TCO)

1009

SOME CHARACTERISTICS OF BETATRON TARGET RADIATION AT 10-25 MeV. A. A. Vorob'yev and V. A. Moskalev. Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz., No. 1, 102-6(1959).

Results of experiments on the spatial distribution of betatron target radiation are reported. It is shown that the experimental data are in good agreement with the theory given by Lowson. The measurements were carried out using a special detector. The detector includes a thimble ionization chamber with a working volume of 1 cm^3 and a graphite wall whose thickness may be varied from 3 mm to the equilibrium value. The detector could be continuously moved over a 1 m radius circle, the rotation axis of the detector passing through the target. The spatial distribution at 25 Mev is in good agreement with the theory. The "effective" energy was determined experimentally by absorbing the radiation in copper and lead. This energy was found to be equal to 4 Mev in the case of 10 Mev betatron. (auth)

1010

HIGH ENERGY, HIGH CURRENT SYNCHROTRON INJECTOR. G. R. Davies (University Coll., London) and P. R. Chagnon (Univ. of Michigan, Ann Arbor). J. Sci. Instr. 36, 306-8(1959) July.

The construction and testing of a pulsed 450 kev injector for an electron synchrotron are described. High voltage is obtained with a spark gap and pulse transformer. The electron-optical system consists of a series of electrodes connected to a voltage divider programmed so as to approximate the field in a space-charge-limited plane diode. Quadrupole lenses are used to optimize the shape of the beam spot and to counteract space-charge spreading. Details are given of the dependence of beam current on energy and on filament power. (auth)

1011

RELATIVE ENERGY CALIBRATION OF ELECTRON ACCELERATORS. E. Matsukawa and B. N. C. Agu (Univ. of Leicester, Eng.). J. Sci. Instr. 36, 316-17 (1959) July.

Measurements of electron transmission through metallic foils suggest that accurate relative calibration of an electron accelerator may be possible using foil transmission data. Standardization of measurement at a predetermined very small transmission ratio for a series of beryllium-foil thicknesses would lead to calibration data nearly independent of apparatus. A circuit for the measurement of electron-beam current ratios is described. This circuit is particularly suited to the measurement of the very small transmissions recommended. (auth)

1012

PRODUCTION OF MAGNET SECTORS FOR 7 GeV PROTON SYNCHROTRON. ACCURACY REQUIRED NECESSITATED DEVELOPMENT OF SPECIAL MANUFACTURING TECHNIQUES. Metallurgia 60, 35-8(1959) Aug.

A 7,000-ton electromagnet core for the 7 Bev proton

synchrotron is being produced in 336 radial sectors. Each sector is composed of 45 silicon steel plates, each $12\frac{1}{2}$ in. thick, weighing nearly 20 tons. The plates were annealed at 800°C and cooled at the rate of 3°C per hour. The machined surfaces are given a coating of strippable lacquer for protection during dispatch and handling. (C.J.G.)

1013

FEASIBILITY OF CURRENT INTENSITY AND ENERGY INCREASE OF MICROTRONS. A. Paulin (J. Stefan Institut, Ljubljana, Yugoslavia). Nuclear Instr. and Methods 5, 107–10(1959) Aug.

The energy gain during the first crossing of the accelerating gap of the microtron resonator, and the transition of the electrons into a phase stable region are investigated. It is shown that for proper operation of the X–band microtron the accelerating gap should not be greater than 3 mm. A modification of the S–band microtron is proposed. Using a magnetic field of 4400 gauss and a peak voltage of 2.3 Mv across an accelerating gap of 21 mm it seems possible to obtain an energy four times greater at the same diameter of the magnet than with the microtrons built so far. (auth)

1014

PULSED 200–KILOGAUSS MAGNET FOR ACCELERATOR EXPERIMENTS. Dale H. Birdsall and Harold P. Furth (Univ. of California, Livermore). Rev. Sci. Instr. 30, 600–1(1959) July.

A 200–kG pulsed air–core magnet system now in use at the Bevatron is described. The rise time of the pulse is 250 μsec, pulse amplitude remaining within 1% of maximum during a 50 μsec interval. The magnet is powered by a 750 μf capacitor bank, normally charged to 13.5 kv with a peak current of 55 ka. (C.J.G.)

1015

INTERSECTING–BEAM SYSTEMS WITH STORAGE RINGS. G. K. O'Neill and E. J. Woods (Princeton Univ., N. J.). Phys. Rev. 115, 659–68(1959) Aug. 1.

The equivalence of fixed- and variable–field particle acceleration systems for the adiabatic damping of synchrotron oscillations is pointed out. These two quite different acceleration methods are therefore able to produce particle beams of equal density for beam stacking purposes. The transfer mechanism between an accelerator and a storage ring is discussed, and the properties of a fast–rise 3–kilogauss beam–switching magnet are shown. It is concluded that the source interaction rate obtainable in a proton storage ring system would be nearly independent of the focusing properties and repetition rate of the injecting accelerator. An improved design for intersecting–beam storage rings is described, in which several well–separated interaction regions could be used for simultaneous experiments. Standard types of alternating–gradient magnets would be required, and the over–all weight of synchrotron plus storage rings would be about one–tenth as large as that of comparable beam–stacking accelerators. (auth)

1016

INVESTIGATION OF THE RELATIVE EFFICIENCY OF ELECTRON CAPTURE IN BETATRON AT VARIOUS PARTS OF INJECTION PULSE. A. P. Komar, Yu. S. Korobochko, and V. T. Shchebolev (Inst. of Physics and Tech., Academy of Sciences, USSR). Zhur. Tekh. Fiz. 29, 852–5(1959) July. (In Russian)

The mechanism of capture was determined by measuring the relative efficiency of electron capture in various injection regions. The analysis of plotted curves indicates that with small emission currents the capture from the injector takes place in front of the injection pulse; with an increase of emission current the capture efficiency drops at the front and rises at the back. (R.V.J.)

1017

TWO PROCESSES FAVORING THE ELECTRON CAPTURE IN THE BETATRON ACCELERATION REGIME. A. P. Komar and Yu. S. Korobochko (Inst. of Physics and Tech., Academy of Sciences, USSR). Zhur. Tekh. Fiz. 29, 856–61(1959) July. (In Russian)

The resonance mechanism in monotonous amplitude variations in radial electron oscillations is described. The process of disorderly changes in radial oscillation amplitudes caused by fluctuations of electron current turns is analyzed. It is postulated that both mechanisms enhance capture in betatron acceleration. The magnitude of amplitude variations in radial oscillations per half–period of oscillation was estimated for the first mechanism and the time required for changing the same amplitude to the identical magnitude by the action of the second mechanism was found. (R.V.J.)

1018

APPARATUS FOR PRODUCING IONS AND BOMBARDING A TARGET THEREWITH FOR USE IN RESTRICTED AREAS SUCH AS BOREHOLES. (to High Voltage Engineering Corp.). British Patent 820,893. Sept. 30, 1959.

A neutron source for borehole logging is described in which an electrostatic accelerator produces neutrons by a d,T reaction. The device includes a 35–watt 0.002 hp electric motor and belt assembly in the assembly designed for 5–in. bores. (T.R.H.)

Plasma Physics and Thermonuclear Processes

1019   AEDC-TM-59-5

Arnold Engineering Development Center, Tullahoma, Tenn.

BIBLIOGRAPHY OF PLASMA PHYSICS AND RELATED SUBJECTS. Maria J. Stollenwerk. Feb. 1959. 77p. Contract AF40(600)–700 S/A 13(59–1). (AD–211155).

This annotated bibliography contains 460 references from foreign and domestic published literature on plasma physics and related subjects. The references are arranged alphabetically by first author. (J.E.D.)

1020   CERN-PS/JGL-2

[European Organization for Nuclear Research, Geneva]. THE PROBLEM OF RUNAWAY ELECTRONS IN PLASMA. Dec. 1957. 13p.

Some of the effects resulting from the application of an electric field E to an infinite volume of uniform plasma are analyzed. The motion of a single electron through plasma is analyzed mathematically. It is concluded that extraction of runaway electrons from plasma is feasible with moderate field strengths. It is also shown that small non-uniformities in plasma density could be tolerated owing to the self-regulating influence of space charge fields. It is argued that the velocity spread in the runaway electron beam is relatively small and that this velocity spread is evened out after a few microseconds. (J.R.D.)

1021   NP-7976

Space Technology Labs., Inc., Los Angeles.

STABILIZATION OF A PINCH BY AN ALTERNATING MAGNETIC FIELD. Erich S. Weibel. June 4, 1958. 21p. Contract AF04(647)-127. (GM-TR-0127-00399).

An analysis of the stability of a plasma column is presented which is confined by a longitudinal magneto-static field on which is superimposed an oscillating transverse magnetic field. The fields are produced by suitably energized conductors wound on a cylinder which is coaxial to the plasma and surrounds it. The plasma is assumed to be perfectly conducting and its interior is field free. It is found that this confinement is stable. (auth)

1022   NP-7977

Space Technology Labs., Inc., Los Angeles.

PLASMA OSCILLATIONS. J. D. Jackson. Dec. 3, 1958. 58p. Contract AF04(647)-165. (GM-TR-0165-00535).

A coherent account is given of various aspects of plasma oscillations. A discussion is offered of disper-sion equations, conditions necessary for the growth or decay of oscillations, the physical mechanism of grow-ing or damping, and the possibility of arbitrary steady state solutions. The mathematical description is in terms of solutions of an initial value problem in small amplitude (linearized) approximations. Some general results are derived for an arbitrary unperturbed veloc-ity distribution of electrons and ions. From these ex-pressions the customary results for a stationary plasma in thermal equilibrium can readily be obtained. For simplicity, one dimensional motion of a simple one component plasma is assumed; collisions between par-ticles and nonlinear effects are not considered. Appro-priate generalizations for two component plasmas (electrons and ions), however, are indicated. (auth)

1023   NP-7978

Space Technology Labs., Inc. Physical Research Lab., Los Angeles.

A MAGNETOHYDRODYNAMIC MODEL FOR A TWO-DIMENSIONAL MAGNETIC PISTON. Rudolf X. Meyer. Mar. 4, 1959. 14p. Contract AF04(647)-309.

The possibility of imparting a very high velocity to an ionized gas by means of a traveling magnetic field in a linear geometry has been recognized for some time. A typical configuration is schematically indicated. The magnetic field moves, and accelerates the gas in the same direction. A shock wave propagates into the cold gas, which is heated to a temperature sufficient for ionization. Due to the finite conductivity of the gas, the plasma diffuses through the field. The mass flow rate of gas leaking through the magnetic piston in the regime of continuum flow is computed. (W.D.M.)

1024   ORNL-2831

Oak Ridge National Lab., Tenn.

CRITICAL CURRENT FOR BURNOUT IN AN OGRA-TYPE DEVICE. Albert Simon. Oct. 23, 1959. 52p. Contract W-7405-eng-26. OTS.

A complete algebraic analysis was obtained for the variation of the steady state ion density n_+ with injected current I in an OGRA-type fusion device (i.e., a device based on trapping of ions by breakup of energetic molecular ions on collision with either the background gas or trapped ions). The most general variation of n_+ with I is shown to be an s-curve with at most three roots of n_+ for a given input I. A physical interpreta-tion of these three roots is given. In addition algebraic

expressions are obtained for the two currents at which the bends in the s-curve occur. It will be necessary to attain the larger current in order to build up a high den-sity plasma when the density is being increased from below. On the other hand, once the high density has been achieved it may be maintained by steady injection of a current larger than the lower value. Parameters cor-responding roughly to the specifications of OGRA are used to obtain some numerical results. The previously published formulas for burnout in DCX are extended to include effects of neutral backstreaming from the input beam and "ion-pumping." (auth)

1025   UCRL-5559

California. Univ., Livermore. Lawrence Radiation Lab.

ELECTRONIC ENGINEERING DESIGN PROBLEMS IN FUSION RESEARCH. Vernon L. Smith. Aug. 1959. 32p. Contract W-7405-eng-48. OTS.

Design problems peculiar to fusion research are dis-cussed. Particular emphasis is placed on the develop-ment of large energy storage systems, and transfer of and utilization of this energy. In addition, design crite-ria for delay systems, data reduction systems, and other problems related to the fusion research program are discussed. (auth)

1026   UCRL-5603-T

California. Univ., Berkeley. [Lawrence] Radiation Lab.

TOY TOP PLASMA INJECTOR. F. Coensgen, W. Cum-mins, and A. Sherman. May 28, 1959. 5p. OTS.

The construction and operation of the plasma injec-tor, Toy Top, used in the magnetic high compression experiments in progress at the Lawrence Radiation Lab. at Livermore are described. The essential part of the injector consists of a stack of deuterated titanium washers $\frac{3}{4}$ in. O.D. and $\frac{1}{2}$ in. I.D. Details of the con-struction are shown. (W.D.M.)

1027   AEC-tr-3672

ADDITIONAL NOTE ON THE STUDY OF WAVES IN A PLASMA RELATIONSHIP BETWEEN ELECTROMAG-NETIC WAVES AND THOSE CALLED HYDROMAG-NETIC. T. Consoli. Translated for Oak Ridge Na-tional Lab. from Report CEN.S.PA 7.701. 3p. OTS.

It is proposed to verify that under a particular condi-tion, a transverse hydromagnetic wave is only a par-ticular case of the extraordinary wave which appears as a result of the anisotropy due to the magnetic field. (W.D.M.)

1028   AEC-tr-3762

THEORY OF CURRENT IN A VACUUM. III. CASE OF SPHERICAL ELECTRODES. S. V. Bellyustin. Trans-lated for Los Alamos Scientific Lab. from Zhur. Eksptl'. i Teoret. Fiz. 9, 857-63(1939). 12p. JCL or LC.

Part I issued as AEC-tr-3650.

A theoretical investigation of the motion of electrons in an electrostatic field between two concentric spheres is reported. A more general case, where the electrons possess identical initial radial velocities and the initial field may have any value, is considered, in contrast to Langmuir, who considered the initial velocity of the electrons and the initial field both equal to zero. The qualitative nature of the solution is ascertained and analytical expressions are obtained that make it possi-ble to calculate the potential distribution, the field, the space charge, the electron transit time, and the static

characteristic. The special result of calculating the static characteristic is pointed out. (auth)

1029   AEC-tr-3762 (Suppl.)
SUPPLEMENTS TO THE THEORY OF CURRENT IN A VACUUM. III. CASE OF SPHERICAL ELECTRODES. S. V. Bellyustin. Translated for Los Alamos Scientific Lab. from Zhur. Eksptl'. i Teoret. Fiz. 13, 238-42 (1943). 9p. JCL or LC.

Part I issued as AEC-tr-3650.

The stationary motion of electrons between concentric spheres is considered when a general radial initial velocity is present. Some properties of the solution are set forth, the regimes are classified, and the apparent capacitance is investigated. (auth)

1030   AEC-tr-3858
INJECTION OF CHARGED PARTICLES IN A MAGNETIC FIELD WITH AXIAL SYMMETRY. Francois Prevot. Translated for Oak Ridge National Lab. from S.N.E. Note No. 30, Apr. 2, 1959. 37p. JCL.

The injection of ions into a magnetic field with axial symmetry exhibits remarkable properties. If the magnetic flux at the interior of the injector is zero, the focusing of ions along the axis is rigorous and independent of the velocity for a wide range of initial velocity. This property is preserved even in the presence of a significant space charge. The yield of capture can be considerably increased by the high density along the axis and the possibility of multiple traversals along the axis. The application of these characteristics in the formation and containment of a confined hot plasma in the magnetic field does not appear to be hindered by fundamental difficulties or insurmountable technological problems. The machines constructed according to this principle permit the attainment of very wide ranges of variation for principal parameters. (auth)

1031   AEC-tr-3859
SELECTION OF THE BASIC PARAMETERS OF A MACHINE SUPPLIED WITH MAGNETIC MIRRORS AND IONIC INJECTION (MMII). Francois Prevot. Translated for Oak Ridge National Lab. from note SNE No. 27, Mar. 24, 1959. 23p. JCL.

The parameters, magnetic confinement field, injection current, and strength of injected current, of a plasma confinement machine with magnetic mirrors and injection of previously accelerated ions are considered. The manner of injection consists of the dissociation of molecular ions in a carbon arc or in any other similar apparatus. Extension of the results to another type of machine can easily be made. (W.D.M.)

1032
A NOTE ON THE CONFINEMENT OF CHARGED PARTICLES BY A MAGNETIC FIELD. B. Lehnert (Royal Inst. of Tech., Stockholm). Arkiv Fysik 15, 579-82(1959).

The motion of charged particles can be strongly confined in the magnetic field of a ring-shaped solid conductor. This hypothesis is discussed relative to experimental applications. (C.J.G.)

1033
STUDY OF THE RELATIVE IMPORTANCE OF ANISOTROPIES IN A WEAKLY PERTURBED PLASMA. Jean-Loup Delcroix and Daniel Quemada. Compt. rend. 249, 1039-41(1959) Sept. 21. (In French)

When a weak electric field (E) is applied to a homogeneous plasma the distribution function of electron velocities can be developed as a Legendre polynomial series which represents the different anisotropies created by the field. It is shown that, under certain conditions, the anistropy of order n is proportional to E^n. In the study of ionized gases, it is convenient to develop the electron distribution function as a series of anisotropies represented by spheric functions. When the local distribution has an axis of symmetry, this development is reduced to: $f(v) = \Sigma_n a_n C_{no} = \Sigma_n a_n v^n P_n(\mu)$ ($\mu = \cos \theta$). For weakly ionized gases the Lorentz model shows that if the medium is acted upon by a weak electric field E, the coefficient a_n is proportional to E^n. This theorem is discussed for strongly ionized gases. (T.R.H.)

1034
EFFECTS OF A CONTINUOUS ELECTRIC FIELD ON A PLASMA: ESTABLISHMENT OF THE EQUATION GIVING THE DISTRIBUTION FUNCTION. André Brin, Jean-Loup Delcroix, and Yves Ozias (Commissariat a l'Energie Atomique, Montrouge, France and École Normale Supérieure, Paris). Compt. rend. 249, 1093-5(1959) Sept. 28.

It is shown that the equation obtained by Spitzer for the distribution function of electrons in a plasma subjected to a continuous electric field can be found by the more general method of Rosenbluth. (tr-auth)

1035
A POST-GENEVA REVIEW OF CONTROLLED THERMONUCLEAR FUSION. E. W. Herold (RCA Labs., Princeton, N. J. and C. Stellarator Associates, Princeton, N. J.). IRE Trans. on Nuclear Sci. NS6, No. 3, 1-10(1959) Sept.

A review is given on controlled thermonuclear fusion with emphasis on fusion reactions and reaction rates, and plasma containment and inductive heating. (C.J.G.)

1036
REPORT ON THE GENEVA CONFERENCE: DEVELOPMENTS IN CONTROLLED FUSION ELECTRONICS. H. W. Van Ness (Univ. of California, Livermore). IRE Trans. on Nuclear Sci. NS6, No. 3, 11-19(1959) Sept.

Electronic developments in controlled fusion presented at the 1958 Geneva Conference are reviewed for the Astron experiment, mirror machines, pinch devices, rotating plasma devices, and stellarators. (C.J.G.)

1037
DEVELOPMENT OF SWITCHING COMPONENTS FOR CONTROLLED-FUSION RESEARCH. David B. Cummings (Univ. of California, Livermore). IRE Trans. on Nuclear Sci. NS6, No. 3, 23-32(1959) Sept.

Needs and applications for ultra-high-power switching are discussed, and various approaches are compared. Capacitor-band experience and circuitry are covered, together with ignitron limitations. A test and cooperative development program led to development of a 2-in. 10 kv ignitron for 30 kamp for 500 μsec, and a 4-in insulated-cathode ignitron for 10 kamp for 20 msec. Times for arc transfer to the wall are given for the 5-in. 5555 ignitron. A radical 19-in. flat ignitron was built, and a 40 kv 200 kamp fast mechanical switch is being developed. Firing delay and jitter are given for the 2-in. ignitron. (auth)

1038
NOTES ON SOME THEORETICAL INVESTIGATIONS OF THE PHYSICS OF HIGH TEMPERATURE PLASMAS. R. Lüst (Max-Planck-Institut für Physik und Astrophysik,

Munich). Nuclear Instr. and Methods 4, 247-8(1959)
June.

A brief survey is given of those 1958 Geneva papers
devoted to the theoretical aspects of high temperature
plasma physics. (auth)

1039

A COMPILATION OF SOME RATES AND CROSS SEC-
TIONS OF INTEREST IN CONTROLLED THERMONU-
CLEAR RESEARCH. C. F. Wandel, T. Hesselberg
Jensen, and O. Kofoed-Hansen (Danish Atomic Energy
Commission Research Establishment, Risö). Nuclear
Instr. and Methods 4, 249-60(1959) June.

A compilation was made of cross sections and cor-
responding time rates, of interest for calculations in
the controlled thermonuclear field. The compilation is
limited to phenomena occurring in fully ionized plasmas,
and includes the relevant cross sections for nuclear re-
actions, Coulomb collisions, and bremsstrahlung radia-
tion. Characteristic time rates for the above phenomena
are given assuming Maxwe lian velocity distributions for
the particles involved. (auth)

1040

REPORT ON LINEAR PINCH DEVICES. R. Latham
and J. A. Nation (Imperial Coll. of Science and Tech.,
London). Nuclear Instr. and Methods 4, 261-72(1959)
June.

Various aspects of the linear pinch as a possible
source of thermonuclear power are discussed. An ap-
proximate assessment of the unstabilized linear pinch
is given relative to the difficulties of obtaining sufficient
temperature and duration. Various geometrical arrange-
ments are proposed for stabilized linear pinch. A re-
view on stability, mechanism of neutron production, tem-
perature achieved, and energy losses is given. (C.J.G.)

1041

BRIEF REVIEW OF THE TOROIDAL STABILISED
PINCH. R. J. Bickerton (Atomic Energy Research Es-
tablishment, Harwell, Berks, Eng.). Nuclear Instr. and
Methods 4, 273-8(1959) June.

A discussion of the stabilized toroidal pinch ap-
proach is given. Stability conditions and heating mech-
anisms are briefly summarized. A survey is given of
experimental setups and results obtained. (auth)

1042

REMARKS ON THE STELLARATOR-SCHEME. L. Bier-
mann (Max-Planck-Institut für Physik und Astrophysik,
Munich). Nuclear Instr. and Methods 4, 279-81(1959)
June.

The mechanisms and operational procedures of de-
vices of the stellarator type are discussed. Difficulties
that may be caused by the use of longitudinal magnetic
fields for ohmic heating are described. (C.J.G.)

1043

MAGNETIC MIRROR MACHINES. [PART] I. M. Bineau,
T. Consoli, P. Hubert, F. Prévot, P. Ricateau, and A.
Samain (Commissariat a l'Energie Atomique, Paris).
Nuclear Instr. and Methods 4, 282-9(1959) June. (In
French)

A review on magnetic mirror machines is given both
from theoretical and experimental points of view. Prog-
ress in the development of various types of machines is
discussed. (C.J.G.)

1044

MAGNETIC MIRROR MACHINES. II. M. Bineau,
T. Consoli, Ch. Maisonnier, F. Prevot, and P. Ricateau

(Centre d'Etudes Nucléaires, Saclay, France). Nuclear
Instr. and Methods 4, 290-321(1959) June. (In French)

A summary of present knowledge on magnetic mirror
machines is given relative to experimental and theoreti-
cal results. Topics covered include: confinement and
stability problems in mirror machine geometries, injec-
tion of particles, and performance of different types of
mirror machine devices. (C.J.G.)

1045

NOTES ON FAST MAGNETIC COMPRESSION OF
PLASMAS. H. L. Jordan, H. Kever, and K. Schindler
(Technische Hochschule, Aachen). Nuclear Instr. and
Methods 4, 322-26(1959) June.

Summaries are given of experimental work carried
out at different laboratories on fast magnetic compres-
sion of plasmas. Theoretical work on the radial motion
of a plasma under magnetic compression is reviewed.
(C.J.G.)

1046

CONFINEMENT OF PLASMA BY RADIO-FREQUENCY
ELECTRO-MAGNETIC FIELDS. C. M. Braams, W. J.
Schrader, and J. C. Terlouw (FOM Inst. for Plasma-
Physics, Rijnhuizen, Jutphaas, Netherlands). Nuclear
Instr. and Methods 4, 327-31(1959) June.

Proposed methods for confinement of plasma by
radio-frequency electro-magnetic fields are reviewed.
Forces on charged particles in rf fields, the pressure
balance, frequency limitations, the power balance of the
plasma, and external power loss are discussed. Briefly
mentioned are confinement in combined d-c and rf
fields and other confinement schemes using alternating
fields. (auth)

1047

RELATIVISTIC ELECTRON BEAM DEVICES FOR
FUSION. J. G. Linhart and A. Schoch (CERN, Geneva).
Nuclear Instr. and Methods 4, 332-45(1959) June.

Equilibrium and stability of relativistic electron
beams are studied with the view of evaluating the poten-
tialities of such configurations for the confinement of
hydrogen plasma. Tentative criteria for the use of these
in a fusion reactor are derived. Particular attention is
given to the heating of plasma and the proposed Astron
scheme. (auth)

1048

PLASMA DIAGNOSTICS BY SPECTROSCOPICAL
MEANS. H. Wulff (Max-Planck-Institut für Physik
und Astrophysik, Munich). Nuclear Instr. and Methods
4, 352-62(1959) June.

Possible applications of spectroscopy in the study of
high temperature thermal and non-thermal plasma ra-
diation are discussed. Measurements on spectral lines
include intensity measurements, determination of tem-
perature, line profiles, and dependence of intensity on
atomic number. Measurements on continuous radiation
include displacements of the series limits, free-bound
and free-free radiation, and plasma frequency. (C.J.G.)

1049

DETECTION OF HEAVY PARTICLES IN THERMO-
NUCLEAR REACTION EXPERIMENTS. L. H. Th.
Rietjens and C. M. Braams (FOM Inst. for Plasma-
Physics, Rijnhuizen, Jutphaas, Netherlands). Nuclear
Instr. and Methods 4, 363-66(1959) June.

A survey is given of methods for detection of heavy
particles resulting from thermonuclear reaction experi-
ments. Measurements of neutron emission as a function
of time and energy are discussed in detail. (auth)

1050

ULTRA HIGH VACUUM TECHNOLOGY. G. L. Munday (CERN, Geneva). Nuclear Instr. and Methods 4, 367-75 (1959) June.

The production of ultra high vacuum ($\approx 10^{-9}$ torr) as a means of eliminating unwanted impurities is considered with reference to thermonuclear devices. The methods of measuring and production of these low pressures are reviewed. Material characteristics are considered in relation to the special requirements of all metal systems which can be baked at 400 to 450°C. Methods of fabricating chambers with demountable joints, windows, and shut-off valves that can withstand repeated bake-out are reviewed. (auth)

1051

ION AND PLASMA SOURCES. T. Consoli, P. Hubert, R. Le Quinio, and D. Véron (Commissariat à l'Énergie Atomique, Paris). Nuclear Instr. and Methods 4, 376-81(1959) June. (In French)

A short survey is given of existing ion and plasma sources with special reference to their application in thermonuclear work. (auth)

1052

SOME REMARKS ON ENERGY STORAGE. D. Th. J. Ter Horst (Short Circuit Lab. KEMA, Arnhem, Netherlands). Nuclear Instr. and Methods 4, 382-5(1959) June.

A short survey is given on storage of energy in capacitor banks, magnetic coils, rotating machinery, and batteries. The costs of storage of energy and the time necessary to release the energy to a gas discharge are compared. (auth)

1053

ELECTRON AND ION RUNAWAY IN A FULLY IONIZED GAS. [PART] I. H. Dreicer (Los Alamos Scientific Lab., N. Mex.) Phys. Rev. 115, 238-49(1959) July 15.

Hydrodynamic equations are used to describe the flow of the electrons and ions of a fully ionized gas under the action of an electric field, E, of arbitrary magnitude. The dynamical friction force exerted by the electrons and ions upon each other through the agency of two-body Coulomb encounters is evaluated. In this connection the electrons and ions were assigned Maxwellian velocity distributions which are displaced from each other by their relative drift velocity. This treatment yields a dynamical friction force which maximizes when the relative drift velocity is equal to the sum of the most probable random electron and ion speeds. For relative drift velocities in excess of this value the friction force decreases rapidly. As a consequence, it is found that a fully ionized gas cannot exhibit the steady-state behavior characterized by time independent drift velocities which has previously been accredited to it by other authors. Instead, it is shown that the electron and ion currents flowing parallel to the existing magnetic fields increase steadily in time (i.e., runaway) as long as a component of the electric field persists along the magnetic field. Drift velocities which greatly exceed the random speeds of the plasma particles can be created in this manner. The theory yields a critical electric field parameter, E_c, which is proportional to the plasma density and inversely proportional to its temperature. It is a measure of the electric field which is required if the drift velocities are to increase and exceed the most probable random speeds in the gas in one mean free collision time. For electric fields in excess of E_c runaway proceeds even faster. In smaller fields

runaway occurs when Joule heating has depressed E_c sufficiently. Several interpretations of E_c are given in terms of the collisional phenomenon involved. Within the framework of the hydrodynamic equations it is shown that the well-known (temperature)$^{3/2}$ electrical conductivity law can be recovered, provided $E \ll E_c$ and the electron temperature is held constant. Numerical solutions giving electron temperature and drift velocity as a function of time are presented for a range of the ratio E/E_c. The assumption of the displaced Maxwellian distribution is justified on the basis of a comparison between the rate of Joule heating and the rate of equipartition of random speeds. Moreover, it is found that the use of an anisotropic velocity distribution does not affect the runaway phenomenon in any important way. The possibility of runaway induced across magnetic fields by steep pressure gradients and its relation to diffusion across magnetic fields is examined and discussed in detail. (auth)

1054

DISSIPATION OF CURRENTS IN IONIZED MEDIA. O. Buneman (Stanford Univ., Calif.). Phys. Rev. 115, 503-17(1959) Aug. 1.

The destruction of electron drifts by instabilities is analyzed. The fastest stable drift is calculated (drift energy 0.9kT) and the energy of a faster drift is found to be dissipated into instabilities within, typically, 30 plasma periods. The growth of a local disturbance in this process is shown to take place without effective propagation. The "turbulent" flow pattern created, eventually, under nonlinear conditions is calculated numerically, demonstrating the tendency toward randomization of the initial drift energy. The effect stops "runaway" in about 100 plasma periods after which there is "heating" by "collective collisions" instead. (auth)

1055

ON A CLASS OF MOTIONS IN MAGNETO-HYDRO-MECHANICS. V. N. Zhigulev. Priklad. Mat. i Mekhan. 22, 389-90(1958).

Solutions of the basic equation of magneto-hydromechanics, whereby the medium is assumed to be ideal, were investigated. Losses by Joulean heat are neglected, and the influences of viscosity and thermal conductivity are not taken into account. The system of the basic equations is completed by an equation of state for the medium of the general form $p = f(\rho,s)$. That class of motions is investigated which satisfies the conditions $(\overline{H}\nabla)\overline{H} = 0$, $(\overline{H}\nabla)\overline{v} = 0$. $\overline{H}$ is the vector of the field intensity of the magnetic field, and $\overline{v}$ is the vector of velocity of the gas particles. The last two conditions physically mean the constancy of the vectors $\overline{H}$ and $\overline{v}$ along the lines of force of the magnetic field. For plane flows and flows symmetrical about an axis for which the vectors of velocity and of the field intensity are normal to each other, the equations can be simplified so that direct analogies to well-known theorems of fluid dynamics can be calculated. A theorem concerning the conservation of the circulation is derived which is completely analogous to the well-known theorem of Thomson. Most of the methods of ordinary hydromechanics can be used for the solution of flows of magneto-hydromechanics without essentially greater work of calculation. Finally, even such media can be considered for which a certain thermal conductivity and viscosity exist, if only the given conditions for the field intensity and velocity are satisfied. (TCO)

1056

SHOCK WAVES IN MAGNETIC GAS DYNAMICS. M. N. Kogan. Priklad. Mat. i Mekhan. 23, 557-63(1959) May-June. (In Russian)

Characteristics and properties of shock polars are analyzed at various magnetic parameters. (R.V.J.)

1057

ABSORPTION OF RADIOWAVES IN THE RESONANT REGIONS OF A NON-HOMOGENEOUS PLASMA. N. G. Denisov. Radiotekh. i Elektron. 4, 388-97(1959).

A magnetically active plasma is generally characterized by two refraction indices. It is known that for certain values of the electron concentration, one of these indices tends to infinity. This condition of the plasma can be referred to as the resonant region, since it is caused by the resonant properties of the plasma. For the purpose of analysis it is assumed that the plasma is situated in a magnetic field and that the electron concentration is dependent only on the coordinate z. (TCO)

1058

INVESTIGATION OF DEIONISATION BY MEANS OF PHOTOELECTRIC METHOD AND METHOD OF PROBES. Zhur. Tekh. Fiz. 29, 845-51(1959) July. (In Russian)

Experimental data, determined by photoelectric and probe methods, are presented on the condition of plasma in the deionization stage. (tr-auth)

Shielding Calculations

1059

ABSORPTION OF 1-Bev PHOTONS. E. Malamud (Cornell Univ., Ithaca, N. Y.). Phys. Rev. 115, 687-94 (1959) Aug. 1.

The total cross section for the attenuation of high-energy gamma rays was measured in various elements. The variation with atomic number, Z, was observed by measuring the absorption of 1-Bev gamma rays in 12 different elements ranging from hydrogen to uranium. Additional measurements were made in copper at 400 and 700 Mev to show the energy dependence of the absorption processes. These results are then combined with those of other investigators at lower energies and show that the theory of pair production in the nuclear field correctly predicts the cross section as a function of atomic number and photon energy. The measurements in low-Z elements give information on pair production in the field of the electron. The results are in closer agreement to the calculations of Wheeler and Lamb than to the estimate of Joseph and Rohrlich. In addition a short experiment was performed to measure the symmetry of the energy distribution between the electron and positron members of the pair. The results show that the energy-sharing curve is symmetrical as predicted by theory. (auth)

Theoretical Physics

1060   KAPL-M-GPC-1

Knolls Atomic Power Lab., Schenectady, N. Y. FEW GROUP THEORY OF WATER GAP PEAKING. G. P. Calame. Aug. 26, 1959. 23p. Contract W-31-109-Eng-52. OTS.

The conventional calculation of power peaking near water gaps assumes an abrupt change in the neutron spectrum at a gap-core interface. The assumption can cause serious errors, and results in discrepancies of up to 60% between theory and experiment. A position dependent spectrum is obtained by the use of diffusion theory, and when used in peaking calculations reduces the discrepancy between theory and experiment to the order of 5-10% or less. Recipes, based on the position dependent spectrum are obtained for the specification of position dependent cross sections which may be utilized in standard diffusion theory codes. Power peakings computed by the latter method differ from experimental values by 15% in the worst cases studied, but nevertheless represent a considerable improvement over the conventional calculations. (auth)

1061   LA-2322

Los Alamos Scientific Lab., N. Mex. THEORY OF EFFECTIVE CROSS SECTIONS. George I. Bell. June 1959. 68p. Contract W-7405-eng-36. OTS.

The theory of effective resonance cross sections for reactor calculations is reviewed in a general form. Homogeneous mixtures, the NR and IM approximations, and theory for capture in isolated lumps are discussed. IM, NR, and canonical approximations are developed and it is noted how higher accuracy may be attainable by retention of the spatial heterogeneity in a multigroup calculation. Theory is generalized to dense lattices and a simple transition between the homogeneous and isolated lump case. It is shown that quite complex lattices can be treated in canonical form. Further improvements for lumps with strong IM scattering are considered. (auth)

1062   NP-7965

Joint Inst. of Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics. ON TESTING THE CONSERVATION OF PARITY IN STRONG INTERACTIONS AT HIGH ENERGIES. V. G. Solov'ev (Soloviev). 1959. 7p.

The π-N high energy reactions are of great interest from the point of view of conservation of parity in strong interactions. The processes are treated, the final states of which contain N particles ($N \geq 3$). Asymmetries in the distribution of produced particles which testify to the non-conservation of parity in strong interactions are investigated. (W.D.M.)

1063   NP-7973

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics. A METHOD OF APPROXIMATE SECOND QUANTIZATION IN THE THEORY OF SUPERCONDUCTIVITY. Zygmunt Galasiewicz. 1959. 23p. (P-353).

The Hamiltonian of a dynamic system of Fermi-particles is transformed by means of the general unitary transformation proposed by N. N. Bogolubov. From this Hamiltonian is obtained the approximate second quantization (a.s.q.) Hamiltonian introducing the Bose—amplitudes with two indices. This Hamiltonian is diagonalized and the collective oscillations considered, especially for the pairs of particles with parallel spins. For the forced collective oscillations the paramagnetic term in the Hamiltonian is also taken into account. This term leads to the additional "spin" current, connected with the elementary excitations with spin-moment ± 1. If the transfer momentum tends to zero, this current vanishes as the terms omitted in obtaining the Meissner-Ochsenfeld effect. (auth)

1064   WAPD-PWR-Ph-293

Westinghouse Electric Corp. Bettis Plant, Pittsburgh. ON THE DOUBLE SPHERICAL HARMONICS APPROXIMATION. P. H. Wackman. June 1958. 18p. OTS.

A new method is presented for solving the one-velocity, one-dimensional transport equation. The method, known as the double P_n approximation, can be described qualitatively as a technique whereby the vector flux is represented by two Legendre polynomial expansions, one in the forward half-sphere and one in the backward half-sphere. Thus, a discontinuity is allowed in the vector flux at $0-90°$. (W.D.M.)

1065

THE PHASE SHIFTS FOR THE THOMAS-FERMI POTENTIAL CORRECTED FOR THE SELF-INTERACTION OF THE ELECTRON. T. Tietz (Univ. of Lódź, Poland). Acta Phys. Acad. Sci. Hung. 10, 169-72(1959).

A formula for the phase shifts for the Thomas-Fermi potential, which does not include the electrostatic self interaction of the electron, is derived using the approximate Rozental solution for the Thomas-Fermi function for free neutral atoms. The derivation of this formula for the phase shift considered is similar to the Born method, and the difference consists only in the fact that instead of Bessel functions hydrogenic functions are taken. (auth)

1066

THE CALCULATION OF THE DIFFERENTIAL ELASTIC CROSS SECTION FOR COMPLEX ATOMS FOR THE SELF CONSISTENT FIELD. T. Tietz (Univ. of Lódź, Poland). Acta Phys. Acad. Sci. Hung. 10, 251-2 (1959).

The differential elastic cross section $I(\phi)$ for complex atoms is derived using the Gaspar formula $Z_p/Z = (e^{-ax}/1\ bx)$, where the constants a and b are given by $a = 0.1837$ and $b = 1.05$. (J.S.R.)

1067

THE THEORY OF ANGULAR OPERATORS. Sorin Ciulli and Jan Fischer. Compt. rend. 249, 1090-2 (1959) Sept. 28. (In French)

A method is presented which permits calculation of angular operators of a reaction of n particles using known L's from simpler reactions, always with n particles but with two fermions less. (T.R.H.)

1068

TRANSPORT PROCESSES IN MULTICOMPONENT LIQUIDS. Benson R. Sundheim (New York Univ.). J. Chem. Phys. 27, 791-5(1957) Sept.

The phenomenological equations are obtained for interacting flows of matter, electricity, and heat. The differential equations of motion of these systems are written down and transformations which effect separation of variables are found, permitting exact integrations to be performed. An examination is made of coefficients of transport and the significance of a reference species is discussed. (auth)

1069

NON-RELATIVISTIC FUNCTIONAL THEORY FOR PARTICLE SYSTEMS. Florence Aeschlimann (Institut Henri-Poincaré, Paris). J. phys. radium 20, 730-5 (1959) Aug.-Sept.

A study was made of the general conditions required to set up a non-relativistic functional theory for systems of particles. Representation of each particle of a system by a space-time function $u_j(P,T)$. Formal classification for the particles of the system with respect to indiscernability and the exclusion principle for the fermions. Using the general theory of predictions, the arguments of the functional for predictions are fixed, functional configuration-space is introduced, and the

general form of the equation for the predictional elements is determined. Conditions incurred by the limiting cases of the usual wave mechanics for systems and of the single particle in the functional theory of particles. Fundamental principle for the equations of motion concerning the particles of a system: each function $u_j(P,T)$ describing a particle of the system obeys a non-linear equation which depends upon the functions $u_K(P,T)$ of the other particles of the system. Brief investigation of the limiting case of classical mechanics. (auth)

1070

DISTRIBUTION OF THE IMAGINARY PART OF THE OPTICAL POTENTIAL. Ken Kikuchi (Univ. of Minnesota, Minneapolis). Nuclear Phys. 12, 305-8(1959) Aug. (1).

The radial dependence of the imaginary part of the nuclear optical potential is calculated by the semi-classical independent particle model with a diffuse nuclear boundary. The method is the same as the one proposed by Harada and Oda, whose results are extended for various energies in this work. It is found that the strong absorption at the nuclear surface is less important for intermediate incident energies. (auth)

1071

LEE MODEL AND THE LOCAL FIELD THEORY. I. Bialynicki-Birula (Warsaw Univ.). Nuclear Phys. 12, 309-13(1959) Aug. (1).

The comparison between the Lee model and the usual local field theory is discussed in a certain simple case. The conclusion is that the difficulties associated with the renormalization in the Lee model do not appear in the local field theory. (auth)

1072

ON THE SINGULARITIES OF A GENERALIZED BRUECKNER t-MATRIX. M. L. Mehta (Centre d'Études Nucléaires, Saclay, France). Nuclear Phys. 12, 333-41(1959) Aug. (1).

It is shown that the t-matrix defined by taking hole-hole interactions together with particle-particle interactions has the same singularity as the original t-matrix of Brueckner, and in addition a symmetrical singularity above the Fermi-surface. (auth)

1073

ANALYTIC PROPERTIES OF THE SCHRÖDINGER AMPLITUDE AT A FIXED ANGLE. J. Bowcock and D. Walecka (CERN, Geneva). Nuclear Phys. 12, 371-88(1959) Aug. (1).

The scattering from a given class of potentials including exchange forces is considered. For a fixed angle the scattering amplitude can be analytically continued into the complex energy plane with the exception of the usual cut along the positive real axis and certain poles and cuts on the negative real axis depending on the nature of the potential. The results are a partial confirmation of the fixed angle dispersion relations recently proposed within the framework of field theory. (auth)

1074

THE GREEN'S FUNCTION METHOD IN QUANTUM STATISTICS. E. S. Fradkin (P. N. Lebedev Physical Inst., Academy of Sciences, Moscow). Nuclear Phys. 12, 465-84(1959) Aug. (2).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 14688.

1075

ON THE IMAGINARY OPTICAL POTENTIAL. R. H. Lemmer, Th. A. J. Maris, and Y. C. Tang (Florida State Univ., Tallahassee). *Nuclear Phys.* 12, 619-24 (1959) Sept. (1).

The imaginary part of the nuclear optical potential for nucleons is investigated in a semi-quantitative way. For simplicity, harmonic oscillator wave functions are used to perform calculations for O^{16} and Ca^{40}. Results indicate that surface absorption is quite important for incident energies up to about 60 Mev. (auth)

1076

NATURE OF NUCLEAR MATTER IN THE FREE-MESON LATTICE MODEL. L. E. H. Trainor and P. C. Sood (Univ. of Alberta, Edmonton, Can.). *Nuclear Phys.* 12, 625-8(1959) Sept. (1).

Possible types of structure of nuclear matter arising from a "free-meson lattice model" for physical nucleons are considered and some of their properties discussed. (auth)

1077

ON SYMPLECTIC INVARIANCE OF THE ENERGY MATRIX IN A NUCLEAR j^N CONFIGURATION. K. Helmers (Physikalisches Staatsinstitut, Hamburg). *Nuclear Phys.* 12, 647-56(1959) Sept. (1).

The energy matrix of a nuclear j^N configuration of maximum isobaric spin is given a convenient form by methods of field theory, and its invariance under the symplectic transformations of Flowers and Edmonds is investigated. A δ-interaction of arbitrary exchange type is shown to lead to an energy matrix that is non-invariant in this sense. (auth)

1078

DIFFUSION THEORY BOUNDARY CONDITIONS. A. Jeffrey (Rolls-Royce, Ltd., Derby, Eng.). *Nuclear Power* 4, No. 42, 103-5(1959) Oct.

The behavior of mono-energetic neutrons in a medium with isotropic scattering and distributed neutron sources is characterized by a one group neutron transport equation. An equation is derived from the above equation for determining the effect of control surfaces of arbitrary shape when extrapolation lengths appropriate to simpler geometrical configurations are known. This equation is then extended to take into account the effects of epithermal neutrons when dealing with heavy absorbers. A diffusion theory estimate is derived for the exact current entering the face of an infinite scattering and absorbing slab. (C.J.G.)

1079

NOTE ON THE CONSERVED CURRENT IN THE WEAK INTERACTIONS. S. Okubo (Univ. of Rochester, N. Y.). *Nuovo cimento* (10) 13, 292-302(1959) July 16.

The relation between the lack of renormalization and the conserved current is investigated. Furthermore, it is proved under some conditions that a conserved current for the strangeness-violating process cannot be constructed. However, if the mass-differences between baryons is neglected, then the construction becomes possible. Some speculations on the weak interactions are given. (auth)

1080

HIGHER BORN APPROXIMATIONS IN NON-RELATIVISTIC COULOMB SCATTERING. C. Kacser (Clarendon Lab., Oxford). *Nuovo cimento* (10) 13, 303-18(1959) July 16.

The first three Born approximations to the differ-ential cross-section for non-relativistic scattering by a Yukawa potential in the limit of zero screening are calculated. The result agrees with the exact Rutherford cross-section for Coulomb scattering. This supports the suggestion made by Dalitz that the divergent higher Born approximations for Coulomb scattering act solely as a phase-factor multiplying the first Born approximation matrix-element. (auth)

1081

OPERATOR FUNCTIONS OF THE PION FIELD OPERATOR. G. Barton (Clarendon Lab., Oxford). *Nuovo cimento* (10) 13, 363-70(1959) July 16.

A method is given for evaluating matrix elements in a bare particle representation of arbitrary operator functions of the pion field operator, with special reference to the functions arising from the equivalence transformation of the leptonic and electromagnetic couplings of nucleons. (auth)

1082

A NOTE ON THE PAULI TRANSFORMATION. B. Touschek (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome). *Nuovo cimento* (10) 13, 394-404(1959) July 16.

Definitions are given of a simple particle of spin $\frac{1}{2}$ and of a theory of the Heisenberg type. It is shown that in a theory of the Heisenberg-type simple particles must have mass 0. It is further shown that in order to obtain particles of mass $m \neq 0$ from such a theory it is necessary to construct at least two asymptotic spinors from the spinor of the Heisenberg-type theory and that these two asymptotic spinors must not transform in the same way under the Pauli transformation. Two asymptotic spinors transforming respectively as $\exp[\pm i\gamma_5 \alpha]$ is discussed as an illustration. (auth)

1083

DIFFERENTIAL EQUATIONS FOR THE RENORMALIZED FIELDS IN THE POINT SOURCE LEE-MODEL AND SCALAR NEUTRAL MESON THEORY. R. Haag and G. Luzzatto (Princeton Univ., N. J.). *Nuovo cimento* (10) 13, 415-29(1959) July 16.

For two simple field theoretical models with infinite renormalization, it is shown that the equations of motion can be formulated as differential equations for the renormalized fields involving only finite quantities. Thus the status of the initial value problem is not changed by the infinite renormalization. The equations involve certain limiting procedures which are closely related to Valatin's work on quantum electrodynamics but are more explicit. (auth)

1084

SPIN-ORBIT POTENTIAL IN PSEUDOSCALAR THEORY. E. Butkov (McGill Univ., Montreal). *Nuovo cimento* (10) 13, 809-17(1959) Aug. 16.

The Levy-Klein method is used to calculate, for pseudoscalar coupling, the spin-orbit potential between two nucleons. The results, carried to two lowest orders in the ratio of meson to nucleon mass, indicate an attractive force for the isotopic spin triplet state and a smaller repulsive force for the singlet state. Quantitative agreement with phenomenological potentials depends, however, on the pair-suppression effects which are still uncertain. (auth)

1085

TWO THEOREMS ON SCATTERING. I. I. Zinnes (Univ. of Oklahoma, Norman). *Nuovo cimento* (10) 13, Suppl. No. 1, 87-99(1959).

Mathematical proofs based on the theory of linear operators defined on a Hilbert space of (square integrable or L^2) state functions are given for two theorems on scattering. Theorem one states that any wave packet representing a free particle develops in time in such a manner that the probability of finding the particle in any finite region of space vanishes in the limit as $t \rightarrow \pm \infty$. Theorem two states that in a multi-channel scattering process the set of (free) Hamiltonians defining the asymptotic motion of the fragments is unique. (C.J.G.)

1086

ANTICOMMUTATOR FOR A NONLINEAR FIELD THEORY. F. L. Scarf (CERN, Geneva). Phys. Rev. 115, 463-7(1959) July 15.

The anticommutator for the Thirring model is computed by ordering the operator $\psi(x)\psi^*(x')$ and evaluating its renormalized vacuum expectation value. The infrared divergence is defined by introducing an ad hoc cutoff. The final expression does not agree with the approximations obtained by using perturbation theory or by using expansion over intermediate states (with the same cutoff). It is also found that Heisenberg's procedures cannot be applied to this two-dimensional problem. (auth)

1087

THEORY OF MULTIPLE SCATTERING: SECOND BORN APPROXIMATION AND CORRECTIONS TO MOLIÈRE'S WORK. B. P. Nigam, M. K. Sundaresan, and Ta-You Wu (National Research Council, Ottawa, Can.). Phys. Rev. 115, 491-502(1959) Aug. 1.

The formula given by Molière for the scattering cross section of a charged particle by an atom, on which the formula for the "screening angle" χ_α in his theory of multiple scattering was based, was examined and found to contain an inconsistent approximation in all orders of the parameter $\alpha_1 = zZ/137\beta$ except the lowest (the first Born approximation). In the present work, the correct expression of Dalitz is used for the single-scattering cross section of a relativistic Dirac particle by a screened atomic field up to the second Born approximation. It is found that the effect of the deviation from the first Born approximation on the screening angle is much smaller than Molière's expression for this quantity would lead one to believe. This is so because the deviation from the first Born approximation is very small at the small angles that go into the definition of the screening angle. In Molière's work, all the effects of the deviation from the first Born approximation on the distribution function $f(\theta)$ for multiple scattering is contained in the quantity B which depends only on χ_α. In a consistent treatment of terms of various orders in α_1, it is shown that there exist additional terms of order $zZ/137$ in the distribution function. These terms, which represent the second Born approximation, become important at large angles. Calculations were carried out for the scattering of 15.6-Mev electrons by Au and Be. The 1/e widths of the distribution function obtained are in good agreement with the experimental result of Hanson et al., whereas Molière's theory gives too great a width compared with the experimental value in the case of Be. (auth)

1088

SEMICLASSICAL THEORY OF INTERNAL RAYLEIGH SCATTERING. A. M. Cormack (Univ. of Cape Town, Rondebosch, Union of S. Africa). Phys. Rev. 115, 619-23(1959) Aug. 1.

The angular distribution of the gamma rays emitted by a bare nucleus with a fixed orientation in space may be modified if the nucleus is surrounded by electrons, because of the elastic scattering of the gamma rays by the electrons. A general expression is given for the angular distribution of the radiation from arbitrary electric and magnetic multipoles scattered by arbitrary electron distributions on the basis of a classical model, and an "internal scattering coefficient" is given explicitly for spherically symmetrical electron distributions. Although the radiation scattered from spherically symmetrical charge distributions is indistinguishable from the unscattered radiation, the internal scattering coefficient was calculated for these on the basis of a Thomas-Fermi atom so that an indication may be obtained of the smallness of the scattering from asymmetries in atomic electron distributions due to molecular or crystal binding effects. (auth)

1089

FORMAL THEORY OF SCATTERING IN THE QUANTUM FIELD THEORY. Smio Tani (Case Inst. of Tech., Cleveland). Phys. Rev. 115, 711-20(1959) Aug. 1.

The advantages of the exponential form of the transformation function are exploited. It is shown how to define the representation in which all effects of the self-field of physical particles on themselves are eliminated while the remainder is presented in the form of an effective velocity-dependent potential among them. The transformation function which transforms eigenfunctions of the free-particle Hamiltonian into eigenfunctions of the total Hamiltonian is spoken of as the paradox, which was pointed out by Van Hove and further studied by Haag with regard to the existence of such a transformation function in quantum field theory, can be circumvented by considering the exponent as its representative. This exponent has a Lorentz-invariant representation. The exponent of the S matrix is related in a very simple manner to the exponent of the transformation function over a finite interval of time. The asymptotic condition as used in the quantum field theory is also analyzed. (auth)

1090

SUPERFLUIDITY OF NUCLEAR MATTER. R. L. Mills and A. M. Sessler (Ohio State Univ., Columbus); S. A. Moszkowski (Univ. of California, Los Angeles); and D. G. Shankland (Wright Patterson AFB, Ohio). Phys. Rev. Letters 3, 381-3(1959) Oct. 15.

A criterion for the superfluidity of infinite nuclear matter was given in the form of a variational principle by Cooper, Mills, and Sessler, (Phys. Rev. 114, 1377 (1959)). Computations are reported which are an improvement over those in CMS in three respects: the effective mass approximation was removed, more realistic two-body potentials were employed, and superior trial functions were obtained. (W.D.M.)

1091

THEORETICAL FORMULA OF CLASSICAL SCATTERING. P. Résibois (Université Libre, Brussels). Physica 25, 725-32(1959) Aug.

Starting with the Liouville equation, an integral formalism is developed to study the two-body problem. It is shown that the "scattering equations" take an intuitive form when expressed in the coordinate space and that the evolution of the velocity distribution function is closely related to the stationary solution of the Liouville equation with appropriate boundary conditions. The formal analogy is stressed with the S matrix point of view in quantum mechanics. (auth)

1092

INTRODUCTORY NUCLEAR THEORY. L. R. B. Elton.
London, Sir Isaac Pitman and Sons, Ltd., 1959. 293p.

The approach in this book is almost entirely phenom-
enological. The book grew out of a lecture course for
final honors physics students at King's College, London.
Topics discussed include qualitative facts about nuclei,
general properties of nuclei, two-nucleon systems at
low energies, nuclear forces, nuclear models, nuclear
reactions, nuclear disintegration, interaction of nuclei
with the electromagnetic field, beta–decay, and meson
theory of nuclear forces. (W.D.M.)

REACTOR TECHNOLOGY

General and Miscellaneous

1093   AECU-4391

[Oak Ridge National Lab., Tenn.].
REACTIVITY EFFECTS OF LARGE VOIDS IN THE
REFLECTOR OF A LIGHT-WATER-MODERATED AND
-REFLECTED REACTOR (thesis). Albert Barnett
Reynolds. June 1959. 309p. OTS.

Submitted to Massachusetts Inst. of Tech.

Reactivity effects of large voids in the reflector of the
Pool Critical Assembly (PCA), an enriched-uranium,
light-water-moderated and -reflected reactor, were in-
vestigated experimentally and theoretically. The three
principal effects which were studied experimentally
were: the variation of reactivity with the size of a void
located at the center of one face of the core (including a
void covering the entire face), the variation of reactiv-
ity with void position on the core face, and the super-
posability of the reactivity effects of voids. The effect
of the largest void on the thermal-neutron flux distribu-
tion was also measured. The experimental value for the
reactivity divided by γ for a void covering entirely the
largest face of a $23.6 \times 20.5 \times 14.4$ in. core was $(2.79 \pm
0.12)\%$, where γ is the ratio of the effective delayed-
neutron fraction to the actual delayed-neutron fraction.
The calculated value of γ for this core was 1.22 ± 0.05.
(auth)

1094   ANL-5945

Argonne National Lab., Lemont, Ill.
THE LONGITUDINAL DISTRIBUTION OF THERMAL
NEUTRON FLUX IN CYLINDRICAL FUEL SPECIMENS
DURING IRRADIATION. F. R. Taraba and S. H. Paine.
Aug. 1959. 23p. Contract W-31-109-eng-38. OTS.

It was found that the longitudinal distribution of the
average thermal-neutron flux on the cross section of a
cylindrical fuel specimen may be expressed by an em-
pirical equation of the type $\phi(z,\tau) = A(\tau) \exp[-B(\tau)z] +
C(\tau)$, $(0 \leq z \leq \lambda)$, where $A(\tau), B(\tau)$ and $C(\tau)$ are poly-
nomials of the second degree, $\tau = 0.91a(\Sigma_{abs} + \Sigma_s)$ and
$\lambda = 0.5935\ a^2 + 6.429a$. The symbol a is used to denote
the radius of the specimen, and z is the axial distance
from the end surface. It was also found that the distribu-
tion of the average neutron flux near the ends of a pair
of cylindrical fuel specimens arranged in a column and
separated by a nonabsorbing material, such as graphite
or aluminum, in which $\Sigma_{abs} << \Sigma_s$, may be expressed by
an empirical equation of the type $\psi(z,\tau) = (p-1) \exp
\{-[\phi(0,\tau)-1/p-1]\ B(\tau)z\} + 1\ (0 \leq z \leq \lambda')$, where $\lambda' =
(p-1/\phi(0,\tau)-1)$. The symbol p is defined as the Wilkins
Effect and depends upon the neutron properties and
separation of the fuel specimens. The Wilkins Effect

must be determined experimentally before the equation
may be applied. (auth)

1095   BMI-1146(Del.)

Battelle Memorial Inst., Columbus, Ohio.
A STUDY OF THE FEASIBILITY OF A TRACER SYS-
TEM FOR LOCATING A FUEL-ELEMENT FAILURE
IN REACTORS. Meyer Pobereskin, Duane N. Sunder-
man, Aaron Eldridge, George D. Calkins, Walston
Chubb, Frank A. Rough, and Ronald F. Dickerson.
Nov. 2, 1956. Decl. with deletions Mar. 22, 1957. 68p.
Contract W-7405-eng-92. OTS.

The results of this investigation indicated that a sys-
tem of tracer elements for location of fuel-element
failure merited further development. The proposed
method consists in adding very small amounts of dif-
ferent pairs of elements to the fuel alloy of each sub-
assembly. In most cases this is less than 0.1 wt. %.
These elements become activated during operation of
the reactor, producing radioisotopes. When a fuel-
element failure has occurred, a portion of the coolant
is analyzed radiochemically for the elements added to
the fuel as tracers. The radioactive species of the
elements that are detected indicate the subassembly in
which the failure has occurred. The elements which
were found to be suitable tracers were Er, Ga, Ho, Ir,
Os, Pt, Ra, Sc, Tb, Tm, and Yb. Radiochemical sepa-
ration procedures were developed for these elements
and checked out on irradiated alloy specimens. It was
determined that the tracer elements did not already
exist in the coolant. Metallurgical studies indicated
that fuel alloy could be prepared with the tracer ele-
ments. The physical properties, particularly hardness,
ductility, and corrosion resistance, of the tracer fuel
alloys were similar to those of fuel alloy without
tracers. (auth)

1096   CEA-917

France. Commissariat à l'Énergie Atomique, Paris.
FLUCTUATIONS STATISTIQUES DU NOMBRE DE
NEUTRONS DANS UNE PILE ($1^{\text{ère}}$ PARTIE). (Statisti-
cal Fluctuations of the Number of Neutrons in a Pile).
V. Raievski. Dec. 1958. 41p.

The theory of the statistical fluctuations in a pile is
extended to the space-dependent case, and gives the
fluctuations of the number of neutrons in a cell of the
core or reflector of the pile. This number changes
through elementary processes occurring at random,
which are capture, secondary sources, fission, and
scattering. Of all these processes, fission is the only
one which changes more than one neutron at a time and
so is responsible for the deviation of the fluctuations
from a Poisson law. The importance of this deviation
depends on the dimensions of the cell compared to the
slowing·down length. When the dimensions are small,
the fluctuations are close to a Poisson law. (auth)

1097   CF-51-7-137(Del.)

Oak Ridge National Lab., Tenn.
LID TANK AND DUCT SHIELDING WORK. Quarterly
Progress Report. C. E. Clifford and E. P. Blizard.
July 28, 1951. Decl. with deletions Apr. 19, 1957. 40p.
Contract [W-7405-eng-26]. OTS.

During the past quarter the Lid Tank was devoted
primarily to measurements concerning the shield for a
Na-cooled reactor. Particular attention was paid to the
design of the inner shield, which protects the Na in the
secondary coolant circuit from activation by neutrons.
Because of the intense chemical reaction of hot Na and
water, the latter will probably not be used in the inner

shield and B_4C is a likely substitute. Experiments on the neutron attenuation in this material have recently constituted the major effort of this facility. The fast neutron attenuation of B_4C was compared to that of water. The addition of B to a unit $Pb-H_2O$ shield was tested for the suppression of capture γ radiation. Improved measuring techniques are reported for measuring radiation attenuation for the shield around the coolant ducts. (W.D.M.)

1098   CF-53-1-286(Del.)
Oak Ridge National Lab., Tenn.
TOWER SHIELDING FACILITY. Preliminary Proposal No. 181-A. Jan. 28, 1953. Decl. with deletions Feb. 20, 1957. 32p. Contract [W-7405-eng-26]. OTS.

Justification, preliminary schematic plans, outline specifications, preliminary cost estimates, and proposed starting and completion dates for the facility are presented. (T.R.H.)

1099   CF-59-10-100
Oak Ridge National Lab., Tenn.
A COMPARISON OF TRANSPORT THEORY AND DIFFUSION THEORY CALCULATIONS FOR THE HIGH FLUX ISOTOPE REACTOR. H. C. Claiborne. Oct. 27, 1959. 7p. OTS.

Comparison calculations for the High Flux Isotope Reactor (HFIR) show good agreement between multigroup diffusion-theory results and transport-theory results. Two-group diffusion theory underestimates the critical mass and the flux peaking. The calculations do substantiate the expectation of obtaining maximum unperturbed thermal fluxes of about 5×10^{15} n/cm²-sec in the HFIR at 100 Mw. (auth)

1100   DEGIS-23(R)
United Kingdom Atomic Energy Authority. Industrial Group H. Q., Risley, Lancs, England.
BIBLIOGRAPHY ON PLUTONIUM BUILD-UP IN REACTORS. B. Yates and G. I. Maughan, comps. Sept. 10, 1959. 13p. BIS.

The production of plutonium by neutron irradiation of uranium in a reactor and its subsequent effect on the reactivity of the reactor are considered in this bibliography. A selection of 62 unclassified references to reports, books, and journal articles are listed. Sources searched were U.K.A.E.A. abstracts index, Nuclear Science Abstracts, Chemical Abstracts (1940-56), and Science Abstracts "A" (1940-57). (auth)

1101   HW-61393
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
HEAT TRANSFER CALCULATIONS FOR CO_2 GAS-COOLED LOOP-PRTR. J. Muraoka. Aug. 4, 1959. 14p. Contract AT(45-1)-1350. OTS.

A CO_2 gas-cooled loop is to be installed in the Plutonium Recycle Test Reactor (PRTR). The primary purpose of the gas loop is to study the in-reactor behavior of graphite and of various other reactor materials in a CO_2 environment. In addition, the loop is designed to be able to irradiate fuel element samples with power levels up to 500 kw. The results of an analytical heat transfer and fluid flow analysis on the various components of the loop and on the expected behavior of the loop are presented. (W.L.H.)

1102   JEN-42
Spain. Junta de Energia Nuclear, Madrid.
CALCULO DE SISTEMAS DE PURIFICACION DE REACTORES MODERADOS POR HIDROCARBUROS. (Cal-

culation of Purification Systems of Hydrocarbon-moderated Reactors). Agustin Alonso Santos. 1958. 23p.

As an introduction to the calculation of the purification systems of hydrocarbon-moderated reactors, the effects of heat and radiation on the polyphenols are considered. The chemical, physical, and nuclear properties are tabulated. The formation velocity of the polymers and gases, pyrolysis, effects of heat on the polymer, and the activity accumulated in the moderator are discussed. The calculation is based on the hypotheses that the radiation catalyzes the formation of polymers, the velocity of the polymerization reaction is constant, the polymer concentration is maintained at a limit which does not adversely affect the heat transfer properties, the velocity of the separation of polymers in the distillation column is in proportion to their concentration in the hydrocarbon, and the pyrolysis causes gaseous products. Formulas are derived expressing the purified flow and the activities accumulated in the distillation residues. The results are applied to the purification system of the Organic Moderated Reactor Experiment. (J.S.R.)

1103   LAMS-2288(Suppl. 1)
Los Alamos Scientific Lab., N. Mex.
PHYSICS OF INTERMEDIATE REACTORS. Supplement. C. B. Mills. Apr. 1959. 81p. Contract W-7405-eng-36. OTS.

Multigroup neutron diffusion and transport equations have been shown to correlate neutron cross sections and simple critical experiments for a wide variety of materials to approximately second order accuracy. This system was used for criticality survey work for the moderators H and C, giving critical radius for moderator to fissionable material atomic ratio and temperature. Critical radius dependence for D_2O, Be, and BeO was computed for U^{235} only. Neutron group averaged cross sections supplementing and correcting previous listings are tabulated. These are consistent with the literature. (auth)

1104   M-3448(Del.)
Clinton Labs., Oak Ridge, Tenn.
PILE TECHNOLOGY, LECTURES 21 AND 22: PRODUCTION AND PROPERTIES OF GRAPHITE. H. G. MacPherson. [194?]. Decl. with deletions July 17, 1959. 16p. OTS.

Flowsheets for production of graphite are presented and manufacturing techniques are discussed. Also a discussion of the structure of graphite is presented along with a discussion of changes produced in carbon stock by graphitization. Properties of AGOT graphite are tabulated along with radiation effects on various kinds of graphite. Data on irradiation of graphite impregnated with U are also included. (J.R.D.)

1105   NAA-SR-3456
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
SRE EXPERIMENTAL FUEL PROGRAM. (INTERIM REPORT). B. R. Hayward and J. H. Walter. Oct. 15, 1959. 45p. Contract AT-11-1-GEN-8. OTS.

A program was set up to develop and evaluate suitable fuels for Sodium Graphite Reactors. The method being used is to irradiate various fuel materials in full-size element designs, in the SRE, under measured temperatures and known reactor conditions. To date, uranium, dilute uranium alloys, thorium-uranium alloys, and UO_2 were fabricated, assembled into fuel elements,

and loaded into the SRE. A schedule was established for these fuels to be evaluated in the SRE hot cell after ir-radiation. New fuel materials are being investigated and will be tested in a similar manner. (auth)

1106   NAA-SR-4050
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
A SIPHON BREAK AS A BLOCKING VALVE.
J. McDonald and W. Marten. Oct. 15, 1959. 29p.
Contract AT-11-1-GEN-8. OTS.

An experiment was conducted to determine the feasi-bility of using the breaking of a siphon as a quick-acting means for stopping sodium flow following a loss of pump power. A 2-in. pipe system with a high-speed free-surface centrifugal pump was used in this investi-gation. Runs were made with sodium at 500 and 940°F, cover gas at various pressures up to 10 psig, and Reynolds numbers up to approximately 360,000. The siphon-break was established as an effective method for rapid flow stoppage; however, a brief reversal of flow follows the initial flow stoppage. An expression for the flow transient following the breaking of the siphon was derived which agreed reasonably well with experimental results. (auth)

1107   NAA-SR-4197
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
THE POWER NOISE TRANSFER FUNCTION OF A RE-ACTOR. M. N. Moore. Oct. 15, 1959. 15p. Contract AT-11-1-GEN-8. OTS.

A formalism is developed to calculate the power noise transfer function for any kinetic model under the assumption that noise may originate in any or all loops of the system. Reactor kinetic equations are general-ized to the macrostochastic equations satisfied by the pile noise. From these, the differential equations of the various correlation functions are determined and solved for the noise spectra. The case of a single-feedback, one-delay-group model is treated in detail. (auth)

1108   NAA-SR-Memo-3535(Rev.)
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
MULTIGROUP ANALYSIS OF NEUTRON FLUX AND CURRENT CHANGES IN A REACTOR DUE TO A "SLAB" CONTROL ROD. R. L. Moore. Feb. 23, 1959. 12p. OTS.

The solution, in closed form, of the Richard's ap-proximation, in the multigroup case, for the neutron flux and current in the vicinity of a control rod slab in an infinite reactor is considered. Equations are given for predicting the neutron flux and current in the slab and adjacent reactor and the activation of a thin foil in a given flux. (W.D.M.)

1109   NP-7999
Lockheed Nuclear Products, Marietta, Ga.
NEUTRON AND GAMMA FLUX MAPPING AT THE RA-DIATION EFFECTS FACILITY. R. L. Gamble, J. K. Grant, H. H. Nichols, R. M. Thornton, and J. H. Wilson. Sept. 1959. 165p. Contract AF33(600)-38947. (NR-60).

The 2200 m/sec neutron flux per watt of reactor power (neutrons/cm^2 sec watt), the fast neutron dose rate per watt (rads/hr watt in ethylene), and the gamma ray dose rate per watt (ergs/gm sec watt in carbon) were measured in the irradiation volumes around the Radiation Effects Reactor for several shield tank con-figurations. Curves are given from which these quanti-

ties can be obtained as a function of distance from the reactor. A complete description is given of the instru-mentation and techniques used in making these meas-urements as well as the theory behind the techniques. (auth)

1110   NP-8001
Lockheed Nuclear Products, Marietta, Ga.
RADIATION EFFECTS REACTOR LOW POWER TESTS.
W. T. Scarborough and D. E. Kahlson. Sept. 1959.
23p. Contract AF33(600)-38947. (NR-66).

Critical loading was determined and a reactivity dif-ference of approximately 0.5% ΔK was measured be-tween the Critical Experiment Reactor and the Radia-tion Effects Reactor. Coefficients of reactivity were determined. Filling and draining the shield tanks caused a variation in the chamber readings, but no measurable reactivity change resulted. Rod calibrations from the CER experiments were verified. Life opera-tion had no effect on reactivity, but produced a slight variation in chamber readings. Radiation levels in the reactor building varied from 1 to 1200 mr/hr at a power level of approximately 300 watts. (auth)

1111   NP-8003
Lockheed Nuclear Products, Marietta, Ga.
RADIATION EFFECTS REACTOR FULL POWER TESTS. W. T. Scarborough and F. L. Amend. Sept. 1959. 16p. Contract AF33(600)-38947. (NR-69).

Rod configuration and shield tank configuration changes had a strong effect on indi.. .ed power level. Consequently, it was necessary to make primary power level determinations from the temperature change of the primary coolant across the core and the coolant flow rate. The Log-N and both micro-microammeter channels were off-scale at full power. This was cor-rected by repositioning the detectors. Operating tem-peratures at full power were well within design limits, and no dangerous radiation levels were detected within the operations building. (auth)

1112   NRL-Memo-819
Naval Research Lab., Washington, D. C.
PROGRESS REPORT ON FAST BREEDER REACTOR SAFETY STUDIES. L. A. Beach, A. G. Pieper, and M. P. Young. July 31, 1958. 25p. (COO-241). Con-tract AT(11-1)-607. OTS.

The design of the mechanical parts of the radiation scanning system to view melting of fuel elements in the TREAT Reactor is nearly completed. Fabrication work on all these parts will be started by early in the next quarter. Problems in fabrication and in particular, the casting of the rotating drum are being studied. Detailed calculations of the signal to background ratio indicated that the drum must be cast with a material approaching the density of lead. Casting the drum with White's Metal (55% bismuth and 45% lead) will provide a signal to background ratio of greater than 85 which is suffi-cient for a reasonable dynamic range. (For preceding period see NRL-Memo-803.) (auth)

1113   NRL-Memo-975
Naval Research Lab., Washington, D. C.
PROGRESS REPORT ON FAST BREEDER REACTOR SAFETY STUDIES. L. A. Beach, A. G. Pieper, and M. P. Young. Sept. 1959. 59p. Contract AT(11-1)-607. (COO-243). OTS.

A Radiation Scanning Device was constructed to ob-serve meltdown of fast breeder reactor fuel elements in the TREAT reactor by means of self gamma-emission. Measurements with the rotating drum in

front of a beam port of the NRL reactor determined that the gamma transmission of the collimating holes averages approximately 40%, and that the space resolution obtainable with the system is better than the desired 0.1 in. The recording and control parts of the system were completed and given a preliminary checkout. The entire system was shipped to the National Reactor Test Site, Idaho, during July for installation into the North access hole of the TREAT reactor. Final check-out of the system will be made early this fall when it will view fuel pins during transient bursts of the TREAT reactor. (For preceding period see NRL-Memo-936.) (auth)

1114　　　ORNL-2778
Oak Ridge National Lab., Tenn.
FISSION PRODUCT POISONING DATA. N. J. Pattenden. Oct. 14, 1959. 28p. Contract W-7405-eng-26. OTS.

Recent measurements of the neutron cross sections and yields of fission products are summarized and compared with previous data. The effects of resonance and thermal absorption are compared. Proposals are made for further work to enable the evaluation of fission product poisoning of reactors to be more complete. (auth)

1115　　　Y-F10-59(Del.)
Oak Ridge National Lab., Y-12 Area, Tenn.
THE SPHERICAL REACTOR WITH A B₄C LAYER BETWEEN CORE AND REFLECTOR. C. B. Mills. July 6, 1951. Decl. with deletions 1957. 15p. Contract W-7405-eng-26. OTS.

A set of equations and constants is derived for a spherical homogeneous reactor with a layer of B_4C between core and reflector. The B_4C "curtain" is considered to define a boundary at which the nuclear reaction stops. In the derivations the B_4C curtain is considered to be infinitely thin. (auth)

1116
THE BELGIAN BR-3 EXPERIMENTAL CENTER. Joseph Wertz (Centre d'Étude de l'Énergie Nucléaire Mol, Belgium). Inds. atomiques 3, No. 7-8, 55-62 (1959). (In French)

The BR-3 reactor and associated equipment are described. The cooling system, electrical service, control, and safety features are discussed. (T.R.H.)

1117
UNIFORMLY SPACED CONTROL ELEMENTS IN A REACTOR: THEORETICAL BASIS OF APPLICATION OF "ABSORPTION AREA" TO REACTOR CONTROL EVALUATION. Lewi Tonks (General Electric Co., Pleasanton, Calif.). Nuclear Sci. and Eng. 6, 202-13 (1959) Sept.

A quantitative but simple theory of the control effect of a uniformly distributed set of thermal poison elements in a hydrogen-moderated bare reactor core was developed. Starting with plane parallel poison sheets, a zero-flux boundary condition, in a slab core and applying Fourier analysis, it was possible to generalize to any boundary condition, to orthogonally intersecting sets of poison sheets in an infinite rectangular core, to control crosses, and cylindrical rods in regular array, to finite rectangular cores, and to finite cylindrical cores. Each element of the control array is associated with a cross-sectional area A_c within the core and within this area is an easily determined effective "absorption area" C. To a rather good accuracy the critical k of the controlled

core is greater than the k of the uncontrolled core by the ratio $A_c/(A_c - C)$. In this the theoretically based conclusion substantiates the intuitionally based and empirically confirmed methods worked out by Greebler, and by Pearlstein, Ruane, and Storm, and furnishes correction terms. (auth)

1118
THE ELASTIC RESPONSE TO INTERNAL BLAST LOADING OF MODELS OF OUTER CONTAINMENT STRUCTURES FOR NUCLEAR REACTORS. J. W. Hanna, W. O. Ewing, Jr., and W. E. Baker (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Nuclear Sci. and Eng. 6, 214-21(1959) Sept.

The results of an experimental study of the elastic response of four geometrically scaled models of nuclear reactor outer containment shells to internal blast loading are reported. The character of response of the shells to dynamic loading was determined with the shells unsupported (suspended in air) and with the shells half-buried in the ground. Geometrical modeling of the response was verified for both support conditions. The results of a static pressure test of one vessel show that dynamic response cannot be inferred from static considerations. (auth)

1119
DETERMINATION OF TIME BEHAVIOR OF NEUTRON DENSITY AND OF REACTIVITY ON THE ARGONAUT REACTOR. W. R. Kimel, W. E. Carey, F. G. Prohammer, and G. C. Baldwin (Argonne National Lab., Lemont, Ill.). Nuclear Sci. and Eng. 6, 233-7(1959) Sept.

Theoretical and experimental results of the time behavior of neutron density as a function of both positive and negative step changes in reactivity are presented. The theoretical results are obtained from solutions of the space-independent kinetic equations of a bare thermal reactor based on the Fermi continuous slowing down model and using six groups of delayed neutrons. Theoretical results are given as a function of both positive and negative step changes in reactivity. Experimental results of reactivity worth and of rod calibrations based on pedagogical experiments with the Argonaut Reactor and verifying the theoretical data are presented together with the details of the pedagogical experiment. An analytically constructed thermal flux function obtained from results of reactivity measurements in the reactor is compared with the actual recorded flux from the reactor. Experimental results obtained with the Argonaut Reactor indicate that the theoretical kinetic behavior predicted are applicable to the actual Argonaut Reactor. (auth)

1120
ON THE USE OF DIMENSIONLESS VARIABLES IN REACTOR KINETICS. Gilbert B. Melese (Columbia Univ., New York). Nuclear Sci. and Eng. 6, 253-4(1959) Sept.

The use of dimensionless variables in reactor dynamics is demonstrated for the case of kinetics without feedback. The dimensionless quantities ($\bar{\tau}^2/\tau^2$ and $\tau/\bar{\tau}^{-1}$) are shown to be quite close for U-233, U-235, and Pu-239 though the total delayed neutron fraction may vary from 1 to 3 and the average mean life by about 50%. (C.J.G.)

1121
DISPERSION-TYPE HEAT-EMITTING ELEMENTS. Veber and Girsh. Vsesoyuz. Sbornik Met. Yader. Energ. i Deistv. Obluchen. Mater. Moscow. Metal-

lurgizdat, 298-318(1956). (Translated from Referat. Zhur. Met. No. 1, 1957, p.200).

A description of methods of preparation and utilization of heterogeneous mixtures, consisting of the fissionable phase dispersed in a continuous matrix made of non-fissionable material (pure metal or alloy), as heat-emitting elements for reactors with elevated specific loads. Problems concerning the concentration and particle size of the fissionable material, and the radiational damage to dispersion systems are examined.

Research Reactors

1122   IDO-16380(Suppl.)

Phillips Petroleum Co. Atomic Energy Div., Idaho
    Falls, Idaho.
STANDARD PRACTICES FOR DESIGN OF MTR AND
ETR SAFETY CIRCUITS. L. H. Jones, ed. Nov. 21,
1958. 7p. Contract AT(10-1)-205. OTS.

The MTR-ETR experiment safety circuit manual is brought up to date by providing ETR power reduction curves and other information on ETR not available at the time the manual was issued, Sept. 15, 1957. (auth)

1123

CONTROL-ROD DRIVE MECHANISM FOR THE
ARGONNE LOW POWER REACTOR. W. J. Kann
(Argonne National Lab., Lemont, Ill.). Chem. Eng.
Progr. 55, Symposium Ser. No. 23, 5-6(1959).

The control-rod drive mechanism for the Argonne Low Power Reactor is a rack-and-pinion type that operates in contact with the primary reactor fluid. The mechanism is located above the reactor, with the pinion drive shaft extending through a pressure-breakdown, collected-leakage seal. It is coupled to appropriate clutches, gears, and drive motor for actuation. The characteristics of the drive mechanism and its design, development, and testing are described. (auth)

1124

THE QUEEN MARY COLLEGE URANIUM-WATER
SUBCRITICAL ASSEMBLY. W. Murgatroyd, W. K.
Mansfield, and J. M. Kim (Atomic Energy Research
Establishment, Harwell, Berks, Eng.). Nuclear Eng.
4, 352-4(1959) Oct.

The aluminum core tank, 4 ft 6 in. cube, is supported centrally by a graphite pedestal. Up to 256 natural uranium-aluminum canned fuel elements can be loaded in the core. Demineralized water is used both as coolant and moderator. A 10 curie Po-Be source is used which gives a uniform thermal flux of $10^4 n/cm^2/sec$ at the base of the tank. A 250-kv d-c rectifier set was erected and an accelerator tube and an iron source are being developed to produce a 1 ma beam of deuterons. A yield in excess of 10^9 or $10^{10} n/sec$ is predicted from such a source for deuterium-zirconium and tritium-zirconium water-cooled targets, respectively. Four main types of flux measurement are being used. (C.J.G.)

1125

SOVIET FAST REACTOR—BR 5. R. R. Matthews
(United Kingdom Atomic Energy Authority, Risley,
Lancs, Eng.). Nuclear Eng. 4, 359-60(1959) Oct.

The BR 5 has a maximum power of 5 mw(t), is fueled with plutonium oxide stainless-steel clad pins, and cooled by sodium. Control is by a nickel reflector external to the central sodium tube. Shielding consists of a 20 in. thick water tank followed by a cast iron ring

16 in. thick, and the whole enclosed in a concrete cell of 43 in. average thickness. The reactor has an experimental sodium loop which can operate up to 600°C and is cooled independently of the main circuit. The inlet and outlet circuits to the reactor are split into circuits provided with isolating and non-return valves, a sodium to NaK heat-exchange, a mechanical pump, and cold trap. One secondary circuit is air-cooled and the other generates steam, mercury being used as the heat transfer medium in the interspace of the double wall shell-and-tube type heat exchanger. (C.J.G.)

1126

THE BROOKHAVEN MEDICAL RESEARCH REACTOR.
Lee E. Farr (Brookhaven National Lab., Upton, N. Y.).
Science 130, 1067-71(1959) Oct.

Design characteristics of the 3 Mw Brookhaven Medical Research Reactor are given. The graphite moderated reactor uses 17 uranium-235 fuel elements and is cooled by natural water. Vertically moving shutters weighing 20 tons are provided to control neutron and other radiation emission through special parts into shielded rooms where studies on neutron capture therapy are conducted. (C.J.G.)

Power Reactors

1127   AECD-4249

Oak Ridge National Lab., Tenn.
SOLUTION OF KINETIC EQUATIONS OF CYLINDRICAL
LIQUID FUEL REACTOR. M. J. Nielsen and J. W.
Webster. Sept. 18, 1951. Decl. with deletions Feb. 20,
1957. 33p. Contract W-7405-eng-26. OTS.

A method is presented for solving the non-linear equations which attempt to predict the kinetic behavior of the liquid-fuel Aircraft Reactor Experiment. Equations describing the flux and temperature of the reactor components are given. Problems considered include response to a sudden control rod motion, response to a sudden change of inlet coolant temperature, and response to a sudden change of inlet coolant temperature when the control rod is activated by a certain function of the inlet and outlet coolant temperatures. (W.D.M.)

1128   AECU-4381

Duquesne Light Co., Shippingport, Penna.
ELECTRICAL CABLE CONDUIT TEMPERATURES, 1A
MAIN COOLANT PUMP AND PRESSURIZER HEATERS.
SECTION I. Test Results DL-S-257-S (RNI No. 2).
First Issue, Sept. 9, 1959. 12p. OTS.

The operating temperatures of the 1A main coolant pump and the pressurizer heater electrical cable conduits with the plant at normal temperature and pressure and at power were determined. The maximum temperatures obtained on the 1A main coolant pump conduits and the pressurizer heater feeder conduit were approximately 123 and 199°F, respectively. The value of the data obtained is questionable as the ambient temperature of the chambers was approximately 108°F, considerably less than the ambient temperature during hot days. The thermocouple on the pressurizer heater feeder conduit was on a spare conduit; therefore, only ambient temperature was being obtained. (auth)

1129   AECU-4396

Oak Ridge National Lab., Tenn.
EVALUATION OF REACTOR TYPES FOR THE SMALL-
SIZE NUCLEAR POWER PLANT PROGRAM. June 5,
1959. 25p. Contract [W-7405-eng-26]. OTS.

The over-all objective of the small-size nuclear power plant program is to develop small reactors that can produce efficient and reasonably economic power at an early date. Under the ground rules laid down by the OROO Task Force, it appeared that only the pressurized water, boiling water, and organic moderated reactors were feasible at this time. A detailed evaluation of the three types was accomplished and is summarized. The OMR is ruled out for the present time because of the lack of a proven fuel element. (W.D.M.)

1130   BAW-1048

Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.
CHEMICAL PROCESSING METHODS AND ECONOMICS FOR VARIOUS LIQUID METAL FUEL REACTORS. R. D. Pierce, W. E. Miller, and H. E. Zellnik. Mar. 1958. 91p. Contract AT(30-1)-1940. OTS.

The economic factors related to chemical processing of the fuel and blanket from liquid bismuth fuel reactors are described and evaluated. Cost data are presented as a function of pertinent reactor parameters, permitting the estimation of costs for any particular reactor and mode of operation. Costs are presented for on- and off-site processing for single- and two-region reactors. Processes are considered for solutions and slurries of both oxides and intermetallic compounds. Technical details useful in interpreting and evaluating cost data are presented in the appendices. These costs are as general as possible, and are essentially independent of other parts of the reactor system. Therefore they are useful in estimating the over-all power cores. (auth)

1131   BMI-1356

Battelle Memorial Inst., Columbus, Ohio.
CORE-TEMPERATURE EXCURSIONS FOLLOWING A PIPING FAILURE IN THE PLUTONIUM RECYCLE TEST REACTOR. Alexis W. Lemmon, Jr., Carl A. Alexander, Lewis E. Hulbert, and Robert B. Filbert, Jr. July 6, 1959. 98p. Contract W-7405-eng-92. OTS.

An evaluation of the temperature excursion and its possible consequences arising from loss of coolant from the Plutonium Recycle Test Reactor (PRTR) was made for four different postulated ruptures in the primary heavy water coolant system. As a basis for the evaluation, a series of computations was made. These were based on incremental heat and mass balances for sections of Zircaloy-clad UO_2 and Pu—Al fuel elements. Solutions to each problem defined by the postulated break size and its location were obtained by finite-difference approximations performed by an IBM 653 machine digital computer. The four postulated ruptures were: (1) a complete parting of the 14-in.-diameter outlet pipe near the upper ring header so that coolant would be lost from both broken ends; (2) a rupture equivalent to a 14-in.-diameter hole in the primary-loop piping adjacent to the upper ring header; (3) a complete parting of a $1\frac{3}{4}$-in. upper jumper; and (4) a complete parting of a $1\frac{3}{4}$-in. bottom jumper. The Pu-Al elements represent the most critical component; melting of these elements would begin about 219 seconds after the rupture occurred if emergency backup light water coolant were not available to the system. It was found that the injection of 750 gallons per minute (gpm) of emergency coolant (375 gpm to each ring header) would be adequate to prevent melting or failure of any reactor component for all cases studied even if injection did not begin until 2 or 3 min after the rupture

occurred. An earlier injection time would, of course, be beneficial. (auth)

1132   CF-55-8-68(Del.)

Oak Ridge National Lab., Tenn.
THERMAL ANALYSIS OF APPR AT MID-LIFE. Joseph G. Gallagher. Aug. 1955. Decl. with deletions May 7, 1957. 44p. OTS.

A thermal analysis of the APPR at mid-life was made on the basis of an estimated flux distribution with the rods partially inserted. The pressure drop and flow distribution across the core were calculated. Hot channel factors were determined for plenum chamber flow maldistribution, plate spacing tolerances, uranium tolerances, and core and clad thickness tolerance. Including these hot channel factors, the maximum surface temperature is 533°F, or 34°F below the saturation temperature corresponding to 1200 psi. Instrumentation and control tolerances affects the nominal values of flow, power, average coolant temperature, and pressure. These tolerances increase the maximum surface temperature and lower the saturation temperature so that the margin is only 16°F. (auth)

1133   DP-385

Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.
HEAVY WATER MODERATED POWER REACTORS. Quarterly Progress Report [for] February, March, and April 1959. L. Isakoff, comp. July 1959. 115p. Contract AT(07-2)-1. OTS.

The economic survey of heavy-water-moderated, natural-uranium-fueled power reactors was completed this quarter. The results showed that the cost of power from a very large boiling-D_2O-cooled power reactor of the pressure tube type (i.e., 9.5 mills/kwh for a 400-Mw(e) capacity) is the lowest cost for electricity from any of the reactors considered in the study, but that it is still as much as 50% higher than the cost of power from fossil-fueled plants of comparable size in the United States. Continued progress is reported on the design and construction of the Heavy Water Components Test Reactor (HWCTR), a high-temperature facility for simultaneously irradiating sizable numbers of fuel elements under power reactor conditions. In particular, the design of the HWCTR reactor pressure vessel, cooling system, and nuclear control system are reviewed. Data are also given on (1) a new technique, explosive compaction, for fabricating clad rods of uranium oxide, (2) the fabrication of oxide and metallic uranium fuels by various other methods, (3) heat transfer burnout of water-cooled fuel elements, and (4) the irradiation testing of prototype power reactor fuels. This is the last quarterly report on the du Pont study. Starting with July, progress reports will be issued monthly. (For preceding period see DP-375.) (auth)

1134   IDO-28537

Aerojet-General Nucleonics, San Ramon, Calif.
ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. PRELIMINARY HAZARDS SUMMARY REPORT FOR THE ML-1 NUCLEAR POWER PLANT. Apr. 22, 1959. 208p. Contract AT(10-1)-880. OTS.

With this is bound: Weather Bureau, Idaho Falls, Idaho. LOCAL CLIMATOLOGICAL DATA WITH COMPARATIVE DATA, 1958.

The ML-1 (mobile, low power) nuclear power plant is described with particular emphasis on the neutronic characteristics, the control and instrumentation system, equipment description, and plant safety considera-

tions. The site is described with reference to geology, climate, and population density. Hazards which would result from both normal and abnormal operation are analyzed in detail with emphasis given to possible excursions and to the distribution of any resultant radioactive products. The hazards described include those arising from power plant operation at the ML-1 site and those involving transport of the shutdown reactor to other sites within NRTS for maintenance. It is concluded that a condition which would be hazardous to the surrounding area could only result from gross physical changes in the reactor core. The maximum credible accident would produce such a change and could only result from a catastrophic failure of the gas piping coupled with the unlikely procedural error of having clear water, rather than borated water, in the operating neutron shield. (auth)

1135   KAPL-1701
Knolls Atomic Power Lab., Schenectady, N. Y.
THE FAST OXIDE BREEDER——A SUMMARY. J. K. Davidson. July 1, 1957. Changed from OFFICIAL USE ONLY Dec. 6, 1957. 25p. Contract W-31-109-Eng-52. OTS.

The current development of a fast breeder fuel cycle based on a core fuel consisting of mixed dioxides of uranium and plutonium is described. A fast reactor system with this oxide mixture as the fuel is potentially capable of producing economical electrical power with relatively small dependence on the market value of the plutonium produced. The potential of the system results from the advantageous properties of the mixed oxide core fuel. The two major advantages of this fuel are: the fuel element should be capable of extremely high burnup since radiation damage is not a problem and void space is available for the accumulation of fission gases; this results in a low processing rate and small reprocessing plant; and the removery process has fewer steps than the usual metal fuel element processes, and fabrication is relatively simple. As a result of these advantages, the cost of the fuel cycle, which must be less than the cost of coal for a conventional plant, is potentially low. The initial work on this system was an investigation of the reactor physics by multigroup calculations. The emphasis of the more recent work is on the development of a satisfactory fuel element and on the development and demonstration of the essential features of the core reprocessing cycle, which will then enable a firm estimate of the fuel cycle cost to be made. A preliminary estimate places this cost at about 1.6 mils/kw-hr. The reactor system in general, the fuel element, and the core fuel cycle are described. (auth)

1136   NAA-SR-Memo-3924
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
COMPARISON OF CALCULATED AND MEASURED GAMMA-RAY DOSE RATES AT SRE INSTRUMENT THIMBLES. R. E. Johnston. June 5, 1959. 31p. OTS.

The adequacy of the calculational techniques employed in the determination of the shielding requirements for the Hallam Power Reactor instrument thimbles was determined. This was accomplished by calculating, by identical methods, the SRE dose rates and comparing them with measured values. The measured dose rate for a similar thimble in SRE was 6.27×10^4 r/hr at 20 Mw power operation. This compares with a calculated value of 5.1×10^4 r/hr for identical conditions. (W.D.M.)

1137   NMI-4383
Nuclear Metals, Inc., Concord, Mass.
POWER REACTOR PROGRAM. Progress Report to E. I. du Pont de Nemours and Company for the Period November 1, 1958 through November 30, 1958. F. S. Gardner, D. F. Kaufman, A. R. Kaufmann, S. Isserow, P. Loewenstein, A. M. Huntress, W. L. Larson, W. J. Richmond, and R. G. Jenkins. Feb. 12, 1959. 20p. Contract AT(30-1)-1565, Sponsor Agreement No. S-31. OTS.

The geometry of the extrusion billet to make driver tubes for the HWCTR has been frozen with the exception of the exact shape of the end seal and core interfaces, which will be determined experimentally during the first full-scale extrusions. Small-scale extrusions have been made to determine the extrusion constant of the core alloy (Zr-9.4 wt. % U). Extrusion of uranium dioxide is being considered under the program for advanced fuel element design. The first attempt yielded a rod of variable diameter having an outer stainless steel cladding over a UO_2 core. Information is being obtained on the factors affecting the failure of a fuel element with a 25-mil artificial defect, permitting exposure of a large area of the core to 350°C water. Special attention is being devoted to the comparison of Tubes 12 and 13 for understanding of the factors responsible for the lower corrosion rate of Tube 13. A tentative explanation of the difference involves a possible slower cooling rate after heat treatment for Tube 12. (auth)

1138   NMI-4384
Nuclear Metals, Inc., Concord, Mass.
POWER REACTOR PROGRAM. Progress Report to E. I. du Pont de Nemours and Company for the Period December 1, 1958 through December 30, 1958. F. S. Gardner, D. F. Kaufman, W. J. Richmond, R. G. Jenkins, W. L. Larson, P. Loewenstein, A. M. Huntress, A. R. Kaufmann, J. P. Pemsler, and S. Isserow. Feb. 17, 1959. 24p. Contract AT(30-1)-1565, Sponsor Agreement No. S-31. OTS.

None of the six enriched tubes for Vallecitos extruded early this month evidenced any breakthrough of Zircaloy, though longitudinal striations were somewhat more severe in these tubes than for the lot of nine. Demonstration that the total Zircaloy requirement for a full-length tube may be reduced from 36.5 to 19.5 lb is one result of the recent full-sized experimental extrusion made at American Brass Company. Development of a fabrication process for the production of 30 driver tubes is well underway. The approximate temperature for equal stiffness of the Zircaloy-2 clad and Zr-9.4 wt. % U core has been determined to be 1300°F, and small-scale tubes have been extruded. The chip method for producing a homogeneous core alloy is being investigated as a back-up for induction melting in graphite and arc melting. Two more extrusions of stainless-clad uranium oxide have been made. One of these has an external appearance similar to that of the extrusion made last month; the other has an essentially uniform diameter with a slight periodic ripple on the surface related to an internal structure of hard oxide wafers of essentially 100% density perpendicular to the extrusion axis and regularly spaced. Individual wafers, comprising elongated grains, give evidence of a preferred orientation. Arc melts are being made of Zr-0.6 wt. % Ni and Zr-0.5 wt. % Ni-0.4 wt. % Cr for evaluation of corrosion in steam at 900°F and 1500 psi. A set of samples from Tube 13 was tested in 350°C steam (600 psi) at Argonne National Laboratory. The results are

presented and compared with data available for tests in 350°C water. Although a direct comparison is difficult, the steam caused more rapid corrosion than water, under the respective test conditions. (auth)

1139　　NP-7945
Sulzer Bros., Ltd., Winterthur, Switzerland.
REPORT ON THE CONSTRUCTION OF A NUCLEAR HEAT AND POWER STATION FOR THE DISTRICT HEATING STATION OF THE FEDERAL INSTITUTE OF TECHNOLOGY. [195?]. 92p.

A detailed description of a 30 Mw, D_2O-moderated and -cooled, graphite-reflected, pressure-tube, natural uranium metal-fueled, space heat and power reactor is presented. The reactor is to be built 40 m underground in two chambers. Reasons for selection of the type, location, materials, etc., are discussed. Schematic drawings on building layout, cooling systems, fuel elements, core arrangement, etc., are given. (W.D.M.)

1140　　ORNL-2819
Oak Ridge National Lab., Tenn.
PROPOSED HELIUM PURIFICATION SYSTEM FOR THE EXPERIMENTAL GAS-COOLED REACTOR (EGCR). F. A. Anderson. Oct. 16, 1959. 60p. Contract W-7405-eng-26. OTS.

Liquid and dry processes suitable for the purification of gases by the removal of CO_2, H_2O, CO, H_2, and hydrocarbons are discussed. Recommendations are given for specific processes to be included in a "dry" (no liquid absorbents or chemicals used) purification system for the helium coolant of the EGCR. The recommended processes include (1) a catalytic converter for the oxidation of CO, H_2, and hydrocarbons to CO_2 and H_2O, (2) cooler-condensers for the removal of the bulk of the H_2O, (3) silica gel adsorbers to complete the removal of H_2O, and (4) Linde Molecular Sieve adsorbers for the removal of CO_2. No provisions are included for the planned removal of radioactive gases or particulates. (auth)

1141　　ORNL-2851
Oak Ridge National Lab., Tenn.
A STUDY OF PROBLEMS ASSOCIATED WITH RELEASE OF FISSION PRODUCTS FROM CERAMIC FUELS IN GAS-COOLED REACTORS. J. A. Lane, L. L. Bennett, H. N. Culver, L. J. King, J. P. Sanders, J. L. Scott, and W. E. Unger. Oct. 28, 1959. 79p. Contract W-7405-eng-26. OTS.

The diffusion of fission products out of the fuel elements leads to increased shielding requirements, a greater hazard due to their possible release to the surroundings, and more difficult maintenance problems. Continuous processing of the contaminated coolant may alleviate the hazard and maintenance problems; however, extensive in-pile loop experiments are needed for a quantitative evaluation of methods. By proper design of major components such as heat exchangers and blowers, direct maintenance of contaminated equipment may be possible, with or without premaintenance decontamination. Such an approach is to be preferred to that of providing remote maintenance facilities which, in the case of the reactors considered, added from 0.7 to 1.8 mills/kwhr to the cost of power. (auth)

1142　　TID-8512
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
20,000 KILOWATT ORGANIC MODERATED POWER PLANT. Oct. 10, 1959. 136p. OTS.

The nuclear power plant described utilizes an organic moderated and cooled reactor as the primary heat source to develop 20 Mw(e). Simple in concept and straightforward in design, the OMR uses a high-boiling synthetic hydrocarbon oil (Santowax-R) as both the moderator and coolant. The pumps, heat exchangers, valves, and piping, are all of ordinary carbon steel. The full-power flow rate of coolant of 6.75×10^6 lb/hr at 625°F is used to generate 272,000 lb/hr steam at 815 psia and 580°F. Major systems in the plant, in addition to the two heat transfer loops, include the degasification of the pressurizing system, the coolant purification system, the pressure-relief system, and decay heat removal system. (W.D.M.)

1143　　UCRL-5625
California. Univ., Livermore. Lawrence Radiation Lab.
THE NUCLEAR RAMJET PROPULSION SYSTEM. Theodore C. Merkle. June 30, 1959. 13p. Contract W-7405-eng-48. OTS.

The most practical nuclear ramjet systems consist of a suitable inlet diffusor system followed by a single-pass, straight-through heat exchanger (reactor) which couples into a typical exhaust nozzle. Within this framework, possibilities are governed by the aerodynamic requirements of flight, the nuclear requirements of the reactor, the chemical problems associated with breathing air, and the mechanical properties of materials at elevated temperatures. The major research and development areas which must be entered in the actual production of such an engine are discussed. (W.D.M.)

1144　　WAPD-C(PC)-23(Del.)
Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.
CHEMICAL SHUTDOWN SYSTEM. Z. M. Shapiro. Sept. 22, 1954. Decl. with deletions Apr. 29, 1957. Includes E-Spec.-545420-D: POISON CHEMICAL CHARGE FOR CHEMICAL SHUTDOWN SYSTEM. 8p. Contract AT-11-1-GEN-14. OTS.

The requirements of the emergency chemical shutdown system are presented. A specification of the chemicals required for the chemical shutdown system is presented. (W.L.H.)

1145　　WAPD-TM-10(Del.)
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
COLD START-UP WITH A TEMPERATURE COEFFICIENT INITIALLY POSITIVE. W. R. Campbell. Sept. 28, 1956. Decl. with deletions May 9, 1957. 16p. Contract AT-11-1-GEN-14. OTS.

Results of simulated cold start-ups of a typical light water moderated power reactor with a temperature coefficient that is positive at room temperature are presented. The conditions under which such start-ups could be accomplished safely are discussed. In the simulation, the temperature coefficient is varied directly with the average coolant temperature in the reactor, becoming more negative as the coolant temperature increases. Various rates of change of the temperature coefficient were studied, with initial coefficients ranging from -0.1×10^{-4} to $+0.6 \times 10^{-4}$ δk/°F. Factors limiting the power, coolant temperatures, and coolant volume expansion are discussed. It is concluded from the typical start-up studied that the rate of average coolant temperature rise would be the limiting factor during a cold start-up. (auth)

1146 YAEC-125

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

QUARTERLY PROGRESS REPORT FOR THE PERIOD JANUARY 1 TO MARCH 31, 1959. H. E. Walchli. May 15, 1959. 79p. For Yankee Atomic Electric Co. Contract AT(30-3)-222, Subcontract No. 1. OTS.

A technical description is presented of the research and development work accomplished and the progress made during the period from January 1 to March 31, 1959 under the Research and Development Program. An evaluation and the resulting conclusions of work performed are given for each project in which definitive progress was made. Fuel pellets for a prototype assembly were made using the abbreviated process. These pellets produced at cost indicated a substantial economic savings could be realized for large quantity orders. A new technique using tube crimping for fuel rod fabrication was successfully applied to Yankee sized fuel rods and specified for Core I. Pressure collapse tests were concluded on Types 304 and 347 stainless steel. Type 348 (Type 347 is same as 348 except for a maximum Ta content of 0.1%) was specified for Core I. Preliminary control rod programming studies revealed areas of localized power peaks when control rods are moved. This effect called "ballooning" was analyzed. Flux distributions calculated by computer techniques were compared with measurements taken from the critical experiments and were found to be in excellent agreement. Testing of the latch-type magnetic jack control rod drive mechanism was completed. Chemistry tests revealed the existence of substantial galvanic attack between stainless steels and other materials of construction. A concentrated program is in effect to determine techniques for reducing this attack. The WCAP-4 loop was delivered to MTR and Westinghouse personnel were assigned to assist in supervising installation. The latest nuclear, mechanical, and thermal design data for the core are given. (For preceding period see YAEC-124.) (auth)

1147 YAEC-168

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

MONTHLY PROGRESS REPORT FOR THE PERIOD SEPTEMBER 1 TO 30, 1959. H. E. Walchli. Oct. 20, 1959. 13p. For Yankee Atomic Electric Co. Contract AT(30-3)-222, Subcontract No. 1. OTS.

Brief reports are given of work on mechanical design, thermal and hydraulic design, control rod development, and radiation damage experiments. (For preceding period see YAEC-165.) (W.L.H.)

1148

THE HIGH TEMPERATURE REACTOR OF BBC/KRUPP. R. Schulten, W. Bellermann, H. Braun, H. W. Schmidt, A. Setzwein, and W. Stürmer. Atomwirtschaft 4, 377-84 (1959) Sept. (In German)

The BBC/Krupp high-temperature reactor uses graphite spheres filled with 20% enriched uranium carbide as fuel and thorium carbide as breeder material. The reactor coolant is a mixture of helium and neon. The steam generator produces superheated steam at 505°C and 75 atm. A detailed description is given of the safety problems and the decontamination arrangements for the primary gas circuits. (auth)

1149

FUEL ELEMENTS FOR HIGH TEMPERATURE REACTORS. G. Matz (Degussa und Kernreaktor Bau- u

Betriebs-G.m.b.H., Frankfurt am Main and Kralsruhe, Ger.). Atomwirtschaft 4, 384-7(1959) Sept. (In German)

Three types of fuel elements for gas-cooled high-temperature reactors are manufactured at the present: heterogeneous spheres for the BBC/Krupp reactor in Germany, homogeneous spheres in the USA, and rod elements with annular fuel discs in graphite casing in the UK. Uranium oxide or carbide and graphite are the materials used. Although high-temperature reactors demand fuel elements of a new type, the continuing study of conventional fuel elements for application in these reactors appears promising. (auth)

1150

THE ECONOMIC DEVELOPMENT OF THE SECOND HEAT CYCLE IN ATOMIC POWER PLANTS. [PART] I. H. Steckler. Energietechnik 9, 291-9(1959) July. (In German)

The economy of nuclear power plants depends on three factors: the enrichment of uranium necessary and U burnup, reactor construction and necessary auxiliary equipment, and the development of the second heat cycle. These factors are discussed, and the third is considered in detail. The economy of external superheating under the conditions found in the DDR, a Russian reactor, is discussed. The total efficiency in saturated steam operation, electric power per kg/hr steam at turbine inlet, total efficiency in superheating to 450 and 500°C, specific heat consumption, and specific heat consumption of superheated part are calculated for the DDR. (J.S.R.)

1151

THE FUTURE DEVELOPMENT OF POWER REACTORS. A. J. Salmon (Associated Electrical Industries, Ltd., Aldermaston, Berks, Eng.). Naturwissenschaften 46, 521-9(1959). (In German)

A survey is presented of the reactors which will serve or can serve within the next ten years for the production of power. The probable electrical production of Canada, eastern Europe, France, India, Great Britain, USA, and USSR is summarized this period, and the amount to be supplied by nuclear energy is estimated. The reactor types for power production are considered with discussion of large thermal reactors, small thermal reactors, and fast reactors. The use of reactors for airplane and ship propulsion is discussed. Other applications of power reactors are briefly mentioned. (J.S.R.)

1152

LATINA PROGRESS REPORT ON CONSTRUCTION. M. Campanini (Agip Nucleare, Italy). Nuclear Eng. 4, 329-31(1959) Oct.

The design specifications and construction of the foundations for the reactor building and turbine house of the Latina Power Station are described. (C.J.G.)

1153

LATINA COMPARISONS WITH BRADWELL. R. D. Vaughan (Nuclear Power Plant Co., Ltd., London) and G. Calabria (Agip Nucleare, Italy). Nuclear Eng. 4, 331-4(1959) Oct.

Comparisons are made of the Latina and Bradwell reactors. The Latina reactor is designed after the Bradwell reactor with exception to improvements gained by Bradwell construction. Through the use of finned tubing in the superheaters instead of plain tubing as used at Bradwell, 33% more heat output is obtained with vessels 1 ft. smaller in diameter, resulting in a net station efficiency increase from 28.2 to 28.4%. Increased pitching and simpler arrangement of control

rods, with access for charging given through a self-locking seal assembly, has resulted in 30% fewer stand-pipes in the Latina reactor. Through design modifications irradiation annealing is possible in the Latina reactor. Modifications governed by site conditions are given. (C.J.G.)

1154

LATINA, DETAILS OF THE BOILERS. B. G. Ediss (Nuclear Power Plant Co., Ltd., London) and E. Torielli (Agip Nucleare, Italy). Nuclear Eng. 4, 334-5(1959) Oct.

The finned tubes of the Latina reactor are produced by continuously welding a flat strip into a helix along the axis of a bare tube by a resistance welding process. This type of tube produced a substantial reduction in tube footage when assessed for a constant power loss. Finned tubes of different lengths allow the circular shape of the shell to be occupied more fully. The reduced vertical height of the matrix makes access of the tube elements through the gas inlet connection adequate. Bifurcations are introduced to reduce the number of shell penetrations. Design modifications relative to earthquakes are discussed. (C.J.G.)

1155

LATINA, LAYOUT OF THE CONTROLS. T. Coxon (Nuclear Power Plant Co., Ltd., London). Nuclear Eng. 4, 336-9(1959) Oct.

The Latina station is to feed into a "star-type" supply network and is required to operate over a power range 20 to 100%. The main turbine and boilers will operate on a dual-pressure cycle. Varying the coolant flow, which is controlled by blower speed, initiates a change in reactor power. An automatic rod control maintains constant reactor channel outlet temperature and maintains flux stability within the reactor. Steam pressure is continuously monitored by pressure transmitters. The reactor can be shut down within a few seconds when a reactor trip is initiated but when one or more main machines trip out, the reactor power is reduced until stable conditions are reached. Should coolant pressure change at an excessive rate, a number of control rods would be automatically released and fall into the core. Excessive rise of coolant temperature will release absorbing metal balls from a magazine into channels in the core. Either of these reactions will insert at least -1% k. Safety precautions in event of reduction in coolant flow are discussed. A diagram is given showing the reactor and its control system. (C.J.G)

1156

LATINA, HANDLING OF ACTIVE EFFLUENTS. L. N. Snell and R. T. Brunskill (Nuclear Power Plant Co., Ltd., London). Nuclear Eng. 4, 339-42(1959) Oct.

Disposal of contaminated shield-cooling air and the carbon dioxide coolant consists of filtering and release to the atmosphere at roof level. Liquid effluents after discharge are confined in a cooling pond for 100 days. The pond is continuously filtered and the level is kept constant by removal of water to an evaporator unit. (C.J.G.)

1157

FIRST BERKELEY VESSEL PROVED. Nuclear Eng. 4, 362-3(1959) Oct.

The first of the 150,000 cu ft Berkeley reactor vessels successfully completed its pressure testing. The test temperature was 575 to 625° and the maximum pressure was 211 psi. (C.J.G.)

1158

TRAWSFYNYDD DESIGN FEATURES. Nuclear Energy Engr. 13, 489-95(1959) Oct.

The Trawsfynydd 500 Mw nuclear power station will employ two natural uranium, graphite-moderated, gas-cooled reactors. Improvements in design include the use of $3\frac{1}{2}$-in.-thick plate in the pressure vessel walls, linked butterfly valves for coolant control, and an improved ratio in core to pressure vessel volume. The fuel elements are natural uranium encased in magnesium alloy cans. A dual steam cycle is utilized.

1159

ANALYSIS OF THE COOLANT EXPANSION DUE TO A LOSS-OF-COOLANT ACCIDENT IN A PRESSURIZED WATER, NUCLEAR POWER PLANT. Tedric A. Harris (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng. 6, 238-44(1959) Sept.

A loss-of-coolant accident in a pressurized water, nuclear power plant is one which permits coolant to escape from the primary system. If such an accident were allowed to proceed uninhibited by corrective measures, the core may lose sufficient coolant such as to permit core heatup. In order to design a system to maintain the core cool, it is necessary to evaluate the coolant blowdown process which occurs after rupture and thereby establish the pressure-time and volume-time relationships of the primary coolant after rupture. The coolant blowdown process after rupture is complex because the two-phase expansion of water and steam obtains after saturation pressure is attained. The analysis of this process utilizes heat, mass and volume balances of the reactor coolant to establish the thermodynamic state of the reactor coolant at any time after rupture within conservative limits. (auth)

1160

POWER REACTOR TECHNOLOGY. Technical Progress Reviews, Vol. 2, No. 4. Dunedin, Fla., General Nuclear Engineering Corp., 1959. 90p. $0.55(GPO).

General research and development are surveyed and progress on specific reactor types is reviewed. Economic analyses and comparisons of pressurized-water, boiling, organic-cooled, and heavy-water plants are made. The subject of fission neutron age in H_2O is treated. Heat transfer studies discussed include: Heat transfer and burnout in water at low pressure, critical heat flux and burnout in water at high pressure, heat transfer with organic coolants, and hot-channel factors. Brief notes are given on containment, radiation attenuation in concretes, and radioisotope MPC in air and water. Refueling methods are considered with reports on refueling programs, reactor performance with various programs, considerations in design of refueling machinery, typical refueling methods (tabulation of 23 reactors), and current designs (NRU, NPD-2, EBR-II, Fermi Fast Breeder, Calder Hall, G2 or G3, Berkeley, and Hunterston). Beryllium is discussed as to properties, radiation damage, and health hazards, along with a radiation damage study of boron−stainless steel. The progress reviews are presented on: Shippingport PWR, distillation of water in D_2O reactors, GCRE-I and -II, Turret experiment, and moderator controlled PWR. (T.R.H.)

1161

REVIEW OF NAVAL REACTOR PROGRAM. p.1-25 of "Review of Naval Reactor Program and Admiral Rickover Award. Hearings before the Joint Committee on Atomic Energy, Congress of the United States, Eighty-

sixth Congress, First Session on Review of Naval Re-
actor Program and Admiral Rickover Award, April 11
and 15, 1959." Washington, D. C., Joint Committee on
Atomic Energy, 1959. 85p. GPO.

The shielding facilities and radioactivity in a ship's
atmosphere are discussed relative to radiation pro-
tection in naval nuclear powered ships. Waste disposal
and port entry are discussed relative to radiation pro-
tection of the public. The economics and performance
of the Shippingport reactor and the reactors of various
naval vessels are evaluated. (C.J.G.)

1162
EARLY HISTORY OF THE PRESSURIZED WATER RE-
ACTOR (PWR) AT SHIPPINGPORT, PA. p.59-71 of
"Review of Naval Reactor Program and Admiral Rick-
over Award. Hearings before the Joint Committee on
Atomic Energy, Congress of the United States, Eighty-
sixth Congress, First Session on Review of Naval Re-
actor Program and Admiral Rickover Award, April 11
and 15, 1959." Washington, D. C., Joint Committee on
Atomic Energy, 1959. 85p. GPO.

1163
TECHNICAL BENEFITS DERIVED FROM THE NAVAL
REACTORS AND SHIPPINGPORT PROGRAMS. p.71-81
of "Review of Naval Reactor Program and Admiral
Rickover Award. Hearings before the Joint Committee
on Atomic Energy, Congress of the United States,
Eighty-sixth Congress, First Session on Review of
Naval Reactor Program and Admiral Rickover Award,
April 11 and 15, 1959." Washington, D. C., Joint
Committee on Atomic Energy, 1959. 85p. GPO.

Major technical benefits derived from the naval re-
actor and Shippingport programs are evaluated. The
development of various reactor fuels and reactor
physics are reviewed. (C.J.G.)

WASTE DISPOSAL AND
PROCESSING

1164   ACNP-5916
Allis-Chalmers Mfg. Co. Atomic Energy Div.,
Milwaukee.
PATHFINDER ATOMIC POWER PLANT STUDY OF
LIQUID AND SOLID WASTE DISPOSAL REQUIRE-
MENTS. M. Armando, R. Corcoran, and D. M. Leppke.
July 20, 1959. 76p. For Northern State Power Co. and
Central Utilities Atomic Power Associates. Contract
AT(11-1)-589.

The quantity and type of liquid waste anticipated from
a plant of this type are itemized. An estimated radio-
active level is assigned for each type of waste for both
corrosion product and fission product contamination.
The same is done for all solid wastes. Evaporization,
demineralization, and dilution are evaluated in terms of
cost, reliability, and operability as alternate forms of
liquid waste treatment. The costs associated with solid
waste disposal are listed. Backwash type filters and
cartridge type filters are compared from a waste dis-
posal viewpoint. A similar comparison is made for
sluice type demineralizers and basket type. Alternate
methods of disposal for combustible waste are also
studied. The conclusions state conceptual specifications
for the liquid waste collection system and indicate that
a treatment system using an evaporator for high level
wastes, existing demineralizers for intermediate level

wastes, and dilution for low level wastes is most prac-
tical. It is further concluded that from a waste disposal
viewpoint, backwash filters and sluice type demineraliz-
ers are preferable. Shipment of contaminated combus-
tible waste to an off-site facility appears to be the most
promising method of disposal. Facilities for storing
filter wastes prior to shipment cannot be justified, but
it probably pays to store resin wastes for at least five
years before processing to ultimate disposal. (auth)

1165   HW-20332
Hanford Works, Richland, Wash.
DECONTAMINATION OF DISSOLVER VENT GASES AT
HANFORD. A. G. Blasewitz, R. V. Carlisle, B. F.
Judson, M. F. Katzer, E. F. Kurtz, W. C. Schmidt, and
B. Weidenbaum. Feb. 16, 1951. Decl. July 6, 1959.
17p. Contract W-31-109-Eng-52. OTS.

The dissolver vent gases constitute the most highly
contaminated gas stream in the present Hanford Sepa-
rations Plants. From the health hazard viewpoint there
are two principal contaminants, radio-iodine and an
aerosol composed of other fission products. An exten-
sive study has been made at Hanford of methods and
equipment to remove effectively these materials. This
investigation has led to the development and adoption of
the silver reactor and Fiberglas filter for iodine and
particulate matter removal, respectively. Plant scale
equipment has been designed and installed in the dis-
solver cells. The first silver reactor—Fiberglas filter
assembly was placed in operation on October 26, 1950.
The efficiencies of the two components have been evalu-
ated. Caustic scrubbing monitors were used to deter-
mine the radio-iodine content of the dissolver vent
gases upstream and downstream from the silver reac-
tor, and CWS Type 6 monitoring filters were used to
determine the particulate decontamination of the Fiber-
glas filter. The monitoring data have established the
I^{131} removal efficiency of the silver reactor to be 99.9%
and the filtration efficiency of the Fiberglas filter bed
to be greater than 99.9% and probably near 99.99%. A
conservative estimate of the minimum useful lives of
the two components (under Hanford conditions) is at
least one year. (auth)

1166   HW-54624
General Electric Co. Hanford Atomic Products Opera-
tion, Richland, Wash.
PROPOSAL FOR PLANT-SCALE SUBMERGED COM-
BUSTION TEST. G. Rey and R. J. Sloat. Sept. 16,
1958. 21p. Contract W-31-109-Eng-52. OTS.

With a 1×10^6 Btu/hr submerged combustion concen-
trator installation, reproducible de-entrainment factors
of greater than 4×10^6 were routinely achieved. On the
basis of the encouraging test results, the installation of
a plant scale 5×10^6 Btu/hr prototype burner for coating
waste concentration in a 750,000 gallon waste tank is
proposed. As presently visualized approximately $2.3 \times
10^6$ gallons of Purex coating waste could be processed
through the initial prototype installation. (W.D.M.)

1167   HW-SA-36
General Electric Co. Hanford Atomic Products Opera-
tion, Richland, Wash.
WASTE DISPOSAL TO THE GROUND, OPERATING
PRACTICES AND EXPERIENCES AT HANFORD. C. E.
Linderoth and D. W. Pearce. July 1959. 12p.
OTS.

The separations plants at Hanford discharge large
volumes of solutions containing radioactive materials
to various ground disposal facilities. These facilities

are described. Data are summarized on the volume and curies discharged through mid-year 1959. Management of large volumes of water as well as control of radioactive materials was required. Extensive research and development efforts in geology, hydrology, mineralogy, soil chemistry, analytical chemistry, and process engineering were applied to the ground disposal problems. As a result of these efforts no demonstrable hazards have been created by the disposal of wastes to ground at Hanford. (C.H.)

1168   HW-SA-39
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
RADIOACTIVE WASTE DISPOSAL—A SIGNIFICANT FACTOR IN THE DEVELOPMENT OF NUCLEAR POWER. PART I. THE PROBLEM OF HIGH-ACTIVITY SOLUTIONS. C. E. Linderoth and W. A. Haney. PART II. THE PROBLEM OF LOW-ACTIVITY SOLUTIONS. J. F. Honstead and L. C. Schwendiman. Mar. 4, 1959. 33p. Contract W-31-109-Eng-52. OTS.

Some of the troublesome control problems encountered in radioactive waste management result from the very wide range and quite low values representing the MPC's of various radioisotopes. Wastes may have a radioactive material concentration within a very broad range, from about 2000 curies per gallon down to barely detectable trace concentrations. Some of the practices and problems of low- and high-activity waste disposal are discussed and related to the growth of nuclear power. (W.D.M.)

1169   HW-SA-40
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
DISPOSAL OF INDUSTRIAL RADIOACTIVE WASTE WATERS AT HANFORD. L. C. Schwendiman, R. E. Brown, J. F. Honstead, C. E. Linderoth, and D. W. Pearce. June 1, 1959. 32p. Contract W-31-109-Eng-52. OTS.

For presentation at ASTM Symposium on Technical Development in Handling and Utilization of Industrial Waste Water, San Francisco, October 11, 1959.

Problems encountered in handling, storing, and diluting radioactive liquid wastes are reviewed. It is pointed out that the geography, geology, and hydrology of the Hanford Works site have permitted the safe disposal to the environment of large volumes of radioactive wastes containing millions of curies of fission isotopes. Ground disposal to hundreds of feet of essentially dry soil is relatively inexpensive and can be safely utilized with proper control and knowledge of soil waste chemistry and of the ground-water hydrology of the region. Disposal to the Columbia River is regulated to insure that isotope concentration at the point of use is at a level safe to those using the water. (C.H.)

1170   HW-SA-41
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
OBSERVATIONAL AND FIELD ASPECTS OF GROUND-WATER FLOW AT HANFORD. W. H. Bierschenk. July 1959. 14p. OTS.

At Hanford, the semi-arid climate, the permeable surficial sediments, and the deep water table combine to produce a situation wherein most of the radioactivity of the chemical effluents is trapped by ion exchange and adsorption phenomena in the sediments as the waste percolates down to the water table. Those wastes that reach the water table move with the ground water toward the Columbia River. Geological and hydrological studies at Hanford have indicated what aquifers are present and their continuity. Hydraulic field tests have been conducted to determine the field permeability of the sediments. Knowing the effective porosity of the material and the quantity of water flowing, the average velocity can be calculated. Results of measurements and estimations of aquifer permeability, water-level contours, and movements of ground water and contamination are presented. (C.H.)

1171   HW-SA-42
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
THE MOVEMENT OF LIQUID THROUGH SOILS. J. F. Honstead. July 1959. 9p. OTS.

Factors governing the rate of movement of water in soils are discussed. The movement of water through a porous medium is described in terms of the degree of saturation of the pores with water. It is pointed out that when radioactive waste disposal to the ground is carried to the point at which the decontaminating capacity of the soil is reduced to an undesirable extent it may be necessary to abandon the disposal site and start disposal operations at a new location. Data are included from studies on Hanford soils. Anticipated research programs in soil physics are outlined. (C.H.)

1172   IDO-12011
Idaho Operations Office. Health and Safety Div., AEC.
LIQUID WASTE DISPOSAL IN THE VICINITY OF THE IDAHO CHEMICAL PROCESSING PLANT (ICPP). Interim Report. Bruce L. Schmalz. June 1959. 29p. OTS.

Studies of the effect of discharging radioactive waste in liquid form to the ground water table in the vicinity of the Idaho Chemical Processing Plant were initiated in 1953 by the Idaho Operations Office of the AEC under a cooperative program with the Ground Water Branch of the U. S. Geological Survey. The progress gained in this program during the calendar year 1958 and January and February of 1959 is the subject of this report together with quantity of waste and the results of monitoring downgradient. A test in which fluorescein dye and a slug of common salt were introduced into the disposal system is also reported. (auth)

1173
FISSION PRODUCT WASTE FROM REACTORS—PROCESSING OF HIGHLY ACTIVE SOLUTIONS. T. V. Healy (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Brit. Chem. Eng. 4, 538–42(1959) Oct.

A discussion is given of the extraction processes in which HNO_3 is used as a salting-out agent for waste products of natural uranium reactors. Extraction processes are given for the removal of cesium-137 and strontium-90 together, cesium by direct precipitation, and cerium-144 and ruthenium-106 by TBP separately. (C.J.G.)

1174
RECOVERY OF RADIOACTIVE CESIUM AT HANFORD. B. F. Judson, R. L. Moore, H. H. Van Tuyl, and R. W. Wirta (General Electric Co., Richland, Wash.). Chem. Eng. Progr. 55, Symposium Ser. No. 23, 1–4(1959)

The raffinate stream from the Purex plant is neutralized with caustic and treated with gaseous ammonia which precipitates the iron hydroxides. Slow precipitation of the iron carries essentially all the fission products except cesium. After centrifugation and disposal of the cake, the pH of the solution is adjusted and the

cesium is precipitated as $Cs_2ZnFe(CN)_6$. After washing, the cesium compound is hydrolyzed by steam. Cesium is water-leached from the solids and evaporated in the presence of chloride ions to produce a stable cesium chloride powder. The conversion of an unused chemical reprocessing plant for the recovery of cesium is discussed. Economic analyses indicate that bulk quantities of cesium-137 could be made available at prices as low as 50 cents/curie. (C.J.G.)

1175

FIXATION OF FISSION PRODUCT WASTES FOR ULTIMATE DISPOSAL. J. R. Grover (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Chem. & Process Eng. 40, 263-7, 270(1959) Aug.

Details are given for fixing fission product wastes in montmorillorite clay. Descriptions are given of various pieces of equipment used in the process at the Hanford Works including remotely operated make—and—break joints and a disposal canister. (C.J.G.)

1176

INDUSTRIAL RADIOACTIVE WASTE DISPOSAL, SUMMARY-ANALYSIS OF HEARINGS, JANUARY 28, 29, 30, FEBRUARY 2, 3, AND JULY 29, 1959, JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES. Washington, D. C. Joint Committee on Atomic Energy, 1959. 44p. (GPO)

The nature of radioactive wastes from various operations is discussed. Waste management at Hanford, Naval, Savannah River, and Shippingport reactors and in fuel reprocessing at Hanford, Idaho Chemical Processing Plant, and Savannah River is evaluated. The progress made on disposal of low- and high-level wastes is reported. The activities of Federal, State, and international agencies relative to safety hazards in waste disposal are discussed. (C.J.G.)

1177

RADIOACTIVE WASTE DISPOSAL FROM U. S. NAVAL NUCLEAR-POWERED SHIPS. T. J. Iltis and M. E. Miles (Bureau of Ships, Washington, D. C.). p.47-55 of "Review of Naval Reactor Program and Admiral Rickover Award. Hearings before the Joint Committee on Atomic Energy, Congress of the United States, Eighty-sixth Congress, First Session on Review of Naval Reactor Program and Admiral Rickover Award, April 11 and 15, 1959." Washington, D. C., Joint Committee on Atomic Energy, 1959. 85p. GPO.

The sources and nature of radioactive wastes from U. S. naval nuclear-powered ships are described and the established waste disposal procedures used for these ships are discussed. The measurements made to detect any effect of wastes discharged by the first ships on the radioactivity of their harbor environs are evaluated. The basic criterion adopted for disposal of radioactive waste from U. S. naval nuclear-powered ships is that disposal should not increase the average concentrations of radionuclides in the surrounding environment by more than one-tenth of the maximum permissible concentrations for continuous exposure listed in National Bureau of Standards Handbook 52. Actual data from the operating ships show that the radioactivity of their wastes is consistently low and has had no detectable effect on the radioactivity of their environment. (auth)

1178

DISPOSAL OF RADIOACTIVE EFFLUENTS FROM U. S. NAVAL NUCLEAR-POWERED SHIPS. H. G. Rickover (Bureau of Ships, Washington, D. C.). p.56-8 of "Review of Naval Reactor Program and Admiral Rickover Award. Hearings before the Joint Committee on Atomic Energy, Congress of the United States, Eighty-sixth Congress, First Session on Review of Naval Reactor Program and Admiral Rickover Award, April 11 and 15, 1959." Washington, D. C., Joint Committee on Atomic Energy, 1959. 85p. GPO.

Procedures are given for radioactive waste disposal from U. S. naval nuclear powered ships and the maximum permissible concentrations of radioisotopes in effluents for discharge within 12 miles from shore. A summary is contained of radionuclide analyses made on Nautilus and Skate reactor coolants. (C.J.G.)

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